NASA
Technical Memorandum 86143

USER's GUIDE FOR THE

NIMBUS 7 ERB

SOLAR ANALYSIS TAPE (ESAT)

J.R. Hickey

E.R. Major

H.L. Kyle

August 1984

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

(NASA-TM-86143) USER'S GUIDE FOR THE NIMBUS 7 ERB SOLAR ANALYSIS TAPE (ESAT) (NASA) 83 p HC A05/MF A01 CSCL 03B

N85-19914

Unclas
G3/92 18132

NASA
Technical Memorandum 86143

USER's GUIDE FOR THE
NIMBUS 7 ERB
SOLAR ANALYSIS TAPE (ESAT)

John R. Hickey
Eppley Laboratory, Inc.
Newport, Rhode Island, 02840

Eugene R. Major
Research and Data Systems, Inc.
Lanham, Maryland 20706

H. Lee Kyle
Goddard Space Flight Center
Greenbelt, Maryland 20771

August 1984

National Aeronautics and
Space Administration

Goddard Space Flight Center
Greenbelt, Maryland 20771

PREFACE

The NIMBUS 7 Earth Radiation Budget (ERB) data set activity is being conducted by NASA, Goddard Space Flight Center. Launched on October 24, 1978 the NIMBUS 7 satellite would have been considered successful if its several experiments had gathered useful data covering one complete year. Nearly six years later over half of the experiments, including the ERB, are in good operating condition and are expected to continue to collect data for several more years.

Monitoring the solar irradiance and its fluctuations is an important part of the ERB experiment. The ERB Solar Analysis Tape (ESAT) has been developed to make these solar observations available to the scientific community in a compact form. This first ESAT contains five years of solar data covering the period November 16, 1978 to October 31, 1983. Additional solar analysis tapes will be issued on a yearly basis as the data is processed.

The NIMBUS 7 ERB Experiment has been guided by the ERB NIMBUS Experiment Team (NET) whose members are listed below. The original NET members were competatively chosen by a NASA Anouncement of Opportunity issued in the fall of 1975. Later the NET elected to membership certain individuals who had made a considerable contribution to the scientific success of the experiment. The ERB solar sensors were furnished by Eppley Laboratory, Inc. and John Hickey, of Eppley Laboratory, has taken the lead in the quality control and analysis of the solar data. All the ERB orbital and daily mean solar data on the ESAT were provided by John Hickey. Solar plage data were provided by Kenneth Schatten and Nate Miller of NASA/GSFC. The ERB Solar Analysis Tape and this User's Guide were put together at Goddard by Research and Data Systems, Inc. under NASA contract NAS 5-27728. This was done under the guidance of H. Lee Kyle, NASA/GSFC, and of John Hickey.

The authors wish to thank Bradley Alton of Eppley Laboratories for his assistance in constructing the improved ERB solar data set; Mitch Weiss (RDS) for the development of software to convert and test the ERB solar data in its final form on ESAT; and Scott Salomonson (RDS) for entering key solar activity parameters into the computer.

ERB NIMBUS EXPERIMENT TEAM (NET) MEMBERS

**	Arking, A.	NASA/GSFC
**	Campbell, G.G.	CIRA, Colorado State University
***	Coulson, K.L.	University of California, Davis
	Hickey, J.R.	Eppley Lab., Inc.
	House, F.B.	Drexel University
	Ingersoll, A.P.	California Inst. of Technology
*	Jacbowitz, H.	NOAA/NESDIS
**	Kyle, H.L.	NASA/GSFC
**	Maschhoff, R.H.	Gulton Industries, Inc.
	Smith, G.L.	NASA/LaRC
	Stowe, L.L.	NOAA/NESDIS
	Vonder Haar, T.H.	Colorado State University

* Jacobowitz was elected team leader in 1976.
He was succeeded in 1983 by Kyle.
** Elected Members.
*** Left the NET because of other committments.

TABLE OF CONTENTS

		Page
	PREFACE	i
	TABLE OF CONTENTS	iii
	LIST OF TABLES	v
	LIST OF FIGURES	v
1.0	INTRODUCTION	1
	1.1 Description of ESAT User's Guide	1
2.0	BACKGROUND	3
	2.1 Background of Nimbus-7 and ERB Experiment	3
	2.2 Operational Schedule	3
	2.3 ERB Solar Channels	3
	2.3.1 Origin of ERB Solar Data	7
	2.3.2 ERB Solar Channel Calibration	7
	2.3.2.1 Channel 10c Calibration	10
	2.3.3 ERB Solar Channel Data on the SEFDT	11
	2.3.3.1 ERB Solar Channel Algorithms	11
	2.3.3.2 Time of Minimum Solar Elevation	14
	2.4 Solar Activity Indicators	16
3.0	DESCRIPTION OF ESAT CONTENTS	18
	3.1 Origin of ESAT Data	18
	3.2 Differences Between ESAT and SEFDT	18
	3.3 Corrections to SEFDT Data	18
	3.4 Origin of Solar Activity Indicators	19
	3.5 ERB Solar Channels	22
	3.6 Solar Activity Indicators	23
	3.7 Missing Data	23
	3.8 ESAT Tape Structure	24

4.0 PHYSICAL STRUCTURE OF ESAT TAPE 26

4.1 Tape Organization 26

4.2 Tape and File Specifications 26

4.3 ESAT Data File Specifications 26

5.0 DAILY MEAN SOLAR IRRADIANCES 36

6.0 REFERENCES 48

Appendix A - NOPS Standard Header File and Trailer Documentation File A-1

Appendix B - Sequence Numbers of SEFDT Tapes Used to Prepare ESAT B-1

Appendix C - Scale Factors for ESAT Data C-1

Appendix D - Data Availability D-1

Appendix E - Sample Output, JCL, and Computer Program E-1

LIST OF TABLES

Table		Page
1-1	Characteristics of ERB Solar Channels	2
2-1	ERB Channel Coefficients	12
4-1	ESAT Orbital Data Record Format	27
4-2	ESAT Daily Mean Data Record Format	28
4-3	ESAT Solar Activity Data Record Format	29

LIST OF FIGURES

Figure		
2-1	Spectral Intervals Monitored by ERB Solar Channels	4
2-2	Typical Solar Channel Schematic	6
2-3	Percent Degradations of Solar Channels	9
2-4	Time of Minimum Solar Elevation	14
2-5	Solar Irradiance vs. Solar Activity Indicators	17
3-1	ESAT Tape Structure	25
5-1	Nimbus-7 Channel 1 Irradiance	30
5-2	Nimbus-7 Channel 2 Irradance	39
5-3	Nimbus-7 Channel 3 Irradiance	40
5-4	Nimbus-7 Channel 4 Irradiance	41
5-5	Nimbus-7 Channel 5 Irradiance	42
5-6	Nimbus-7 Channel 6 Irradiance	43
5-7	Nimbus-7 Channel 7 Irradiance	44
5-8	Nimbus-7 Channel 8 Irradiance	45
5-9	Nimbus-7 Channel 9 Irradiance	46
5-10	Nimbus-7 Channel 10C Irradiance	47

1.0 INTRODUCTION

A compact Nimbus-7 ERB Solar Analysis Tape (ESAT) data set has been compiled to facilitate the solar science community's access to ERB solar measurements. These measurements include the total solar irradiance and six spectral regions as listed in Table 1-1. The first ESAT tape contains a collection of five years of solar data derived from the ERB Solar and Earth Flux Data Tapes (SEFDT). This data set will contain the orbital solar data as derived from the SEFDT and the computed daily mean solar data derived from the SEFDT by Eppley Laboratories. The data set covers the period from November 16, 1978 to October 31, 1983. The ERB instrument is normally on 3 out of every 4 days and makes approximately 14 solar observations per day. The SEFDTs contain the raw counts and calibrated irradiances for each observation period whereas only one average irradiance value per channel per observation is given on the ESAT. For inclusion on the ESAT, the SEFDT data has been carefully sorted and questionable observations rejected. Certain common solar activity indicators are also included on the ESAT to facilitate analysis of the data. Data will be available on one (1) 1600 BPI Computer Compatible Tape (CCT). Supplemental ESAT tapes will be made as the ERB data becomes available. Each supplemental tape is expected to contain one year of data in the same format as the first tape.

1.1 Description of ESAT User's Guide

The ESAT User's Guide will describe the contents of the ERB Solar Analysis Tape (ESAT), the origins of ESAT data, method of processing and corrections to the data. A brief review of the Nimbus-7 Earth Radiation Budget (ERB) experiment and overview of solar activity indicators useful to satellite-based solar-terrestrial studies is included. This User's Guide will serve as the principal document for the ESAT by the user community.

Table 1-1
Characteristics of ERB Solar Channels

Channel	Sensor (c) Type	Wavelength Limits (μm)	Filter	Solar Irradiance (d) Air Mass Zero (Wm^{-2})	Gain	Noise Equivalent Irradiance (Wm^{-2})
1	N3	0.2 – 3.8	Suprasil W	1370	692.3	1.77×10^{-2}
2 (a)	N3	0.2 – 3.8	Suprasil W	1370	685.8	1.77×10^{-2}
3	N3	⟨0.2 to⟩ 50	None	1370	607.2	1.43×10^{-2}
4	N3	0.526 – 2.8	OG530	970	974.5	1.94×10^{-2}
5	N3	0.698 – 2.8	RG695	679	1339.4	1.91×10^{-2}
6	N3	0.395 – 0.508	Interference Filter	206	8512.7	3.58×10^{-2}
7	N3	0.344 – 0.460	"	166	17964.7	5.73×10^{-2}
8	N3	0.300 – 0.410	"	109	26985.3	7.55×10^{-2}
9	K2	0.275 – 0.360	"	57	9808.6	0.94×10^{-2}
10C (b)	H-F	⟨0.2 to⟩ 50	None	1370	2791.0	2.39×10^{-2}

Notes: (a) Channels 1 and 2 are redundant. Channel 1 is normally shuttered and is opened periodically to adjust value of Channel 2.
(b) Channel 10C is a self-calibrating cavity channel added to Nimbus 7 and replacing a UV channel on Nimbus 6.
(c) All are types of Eppley wire wound thermopiles.
(d) Values obtained from adjusted Nimbus 6 results.

- The unencumbered FOV for all channels is 10 degrees; the maximum field is 26 degrees for Channels 1 through 8 and 10C. The maximum FOV for Channel 9 is 28 degrees.

2.0 BACKGROUND

2.1 Background of Nimbus-7 and ERB Experiment

A brief background on the Nimbus-7 ERB experiment is presented here. The user is refered to Jacobowitz, et al., (1984) for more detailed descriptions of Nimbus-7 and the ERB experiment. The Nimbus-7 spacecraft was launched on October 24, 1978 and placed into a 955 km, sun-synchronous polar orbit with ascending-node and descending-node equator crossings at noon and midnight respectively. The orbital period is about 104.16 minutes.

The Earth Radiation Budget (ERB) experiment is one of seven experiments aboard the Nimbus-7. The objectives of the ERB experiment are twofold. First, to determine, over a one year period, the radiation budget of the earth by simultaneous measurement of:

(1) Incoming solar radiation

(2) Outgoing earth reflected (shortwave) and earth emitted (longwave) radiation;

and second, to develop angular models of the reflection and emission of radiation from clouds and earth surfaces (Taylor, et al., 1983a, 1983b, 1984)

2.2 Operational Schedule

The ERB instrument normally operates on a three-day-on, one-day-off duty cycle. The first operational science data were available from November 16, 1978. The first data year starts on November 1, 1978 and December 1978 is considered the first month of monthly and seasonal products. The ESAT data starts on November 16, 1978. As of the summer 1984, high quality solar data was still being received from the ERB instrument and we expect to continue to receive data for several more years.

2.3 ERB Solar Channels

Incoming solar radiation is measured by ten spectral channels. Measurements are taken as the satellite crosses the southern terminator heading northwards. Table 1-1 lists the characteristics of the solar channels. Figure 2-1 shows the ERB solar channel responses superimposed on the 1971 NASA Standard Curve of Extraterrestrial Solar Spectral Irradiance. Figure 2-2 shows a cross-sectional drawing of the typical-filtered solar channel.

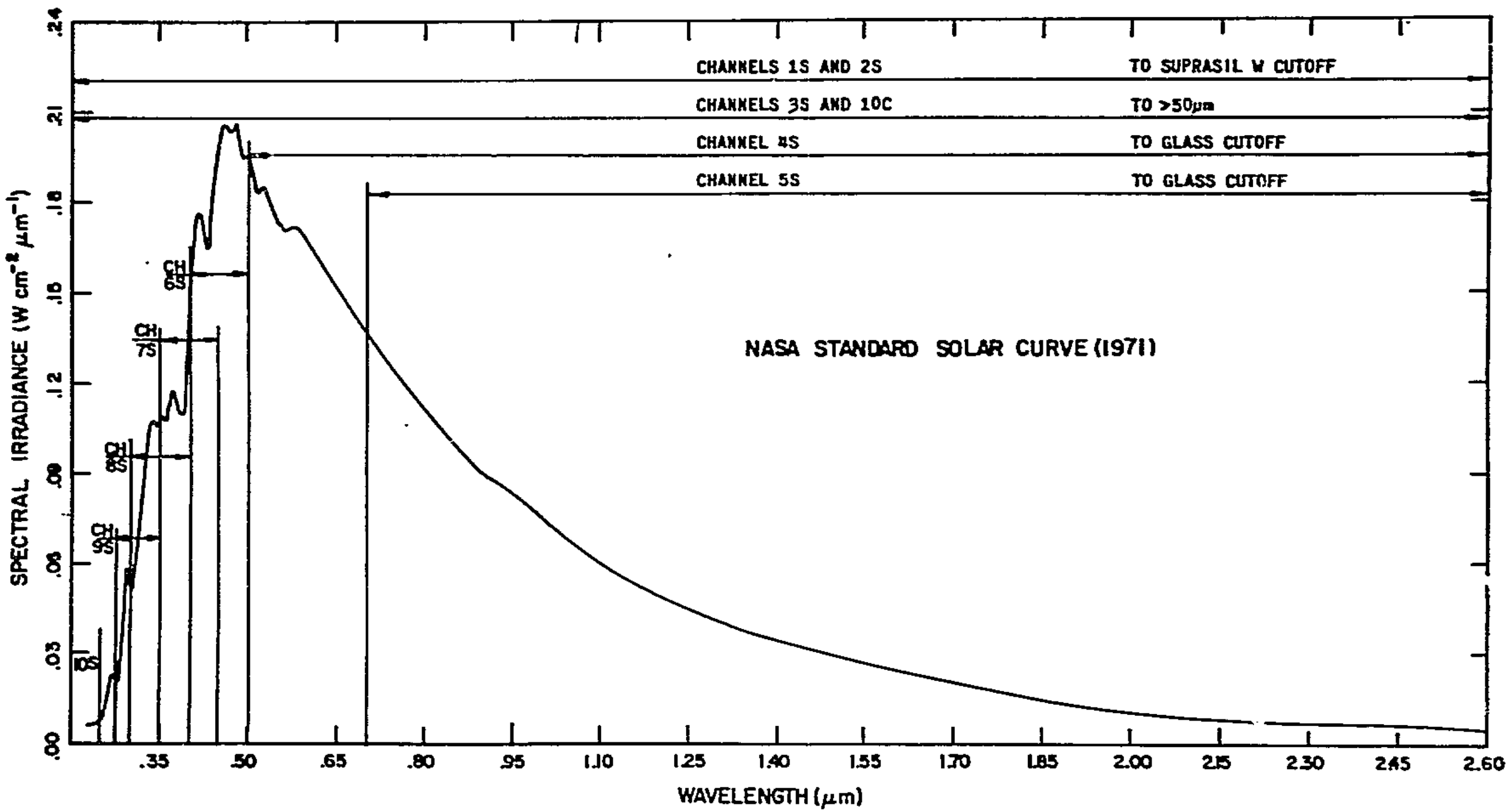


Figure 2-1. Spectral Intervals Monitored by the ERB Solar Channels (With 1971 NASA Standard Extraterrestrial Solar Curve)

Incoming radiation enters the sensor through a protective window. After passing through a spectral filter, it passes through a second window and strikes a 3M (Inc.) black-painted thermopile detector surface. The first protective window minimizes the effects of charged particles, whereas the second window reduces the effects of solar heating of the filter and reradiation to the detector. The whole interior of the cell was anodized to reduce the reflection of solar radiation onto the detector.

Each of the 10 solar channels is an independent, individual modular element with a mated amplifier as part of the unit. The sensors are advanced versions of wire-wound type thermopiles. There are no imaging optics in the solar channels—only filters, windows, and apertures. No optical amplification is required to maintain high signal-to-noise ratios because of the high thermopile sensitivities and state-of-the-art electronics used. Channels 1 and 2 are duplicate, channel 1 being the reference for channel 2 for the in-flight calibration program. Channel 1 is normally shuttered.

Channels 4 and 5 contain broad bandpass filters with transmittance spectra matching those of the standard Schott glasses, OG530 and RG695, of the World Meteorological Organization. The interference filters on channels 6-9 are deposited on Suprasil W (grade 3) fused silica substrates to minimize degradation. Blocking outside the primary transmission bands is achieved by interface layers only. No radiation absorbing glasses are used.

The spectral intervals in the 0.2 μm to 0.526 μm, 0.526 μm to 0.695 μm, and 0.20 μm to 0.695 μm range is obtained by differential treatment of the channel 4 and 5 data together with readings obtained from channel 2. Channels 1 through 8 have type N3 thermopiles; channel 9 has type K2. Channel 10C has a modified model H-F self-calibrating cavity element. The cavity is mounted onto a circular wire-wound thermopile. The electric heater used for self calibration is energized when a "GO/NO GO" heater command is issued. The thermopile output and the heater voltage and current are then submultiplexed into the channel 10C data system.

The solar channel assembly is located on the side of the spacecraft facing in the direction of spacecraft motion. The assembly can be rotated 20° in 1° steps to either side of the spacecraft's forward direction in order to acquire an on-axis view of the sun under the expected variation of the satellite orbit plane with respect to the sun. The Solar channels were included on the ERB

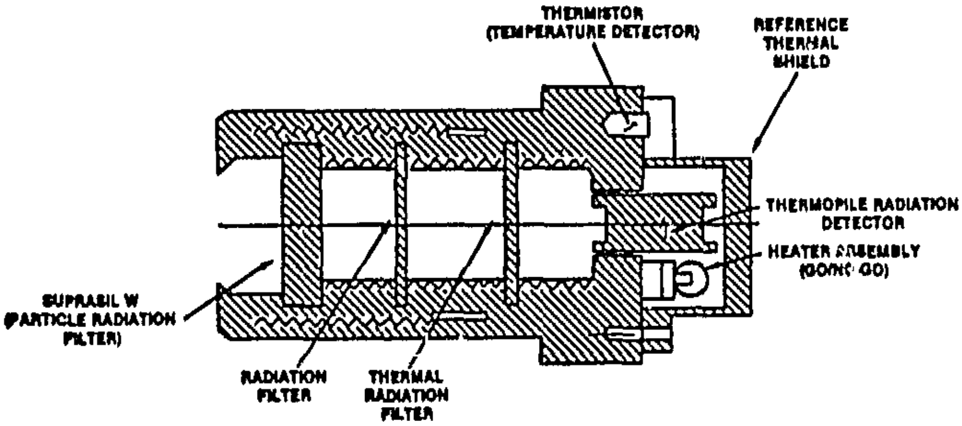


Figure 2-2: Typical Solar Channel Schematic (Jacobowitz, et. al., 1984)

to identify spectral regions of solar variability in the visible and near UV and to yield information on uncertainties in the present values of the solar emission spectrum.

2.3.1 Origin of ERB Solar Data

When the ERB instrument is on, measurement of the solar irradiance by the 10 solar channels are made once per orbit as the Nimbus-7 spacecraft crosses the southern terminator just before its northward movement over the sunlit side of the earth. The instrument views space as a reference before and after each solar exposure. The mission allows for up to 14 measurements per day at approximately 104 minute intervals. For the channel 10c cavity radiometer, the solar disk is completely within the cavity field of view (10°) for approximately 200 seconds during each 104 minute orbit. Therefore, a single orbit contains a solar record of 200 raw count samples which are digitized on an 11-bit quantization scale. A smoothed estimate of solar irradiance for each solar measurement, approximately 14 values per day, can be averaged to generate a best daily estimate of the solar constant (Hickey, et al., 1983).

2.3.2 ERB Solar Channel Calibration

Pre-launch

The reference for the pre-flight absolute calibration of the ERB solar channels was the World Radiometric Reference (WRR) scale which is embodied in a number of self-calibrating cavity radiometers. Solar channel 10c of the ERB is such a device. This new scale can be referenced to previous scales such as the International Pyrheliometric Scale (IPS 1956). The four major solar channels (1, 2, 3, and 10c) have been directly intercompared with self-calibrating cavity instruments of the JPL-PACKRAD and Eppley model H-F types.

For transfer operations, a solar simulator was used as a source and a normal incidence pyrheliometer (NIP) was employed, both traceable to the WRR. When calibrating the filtered channels (4, 5, 6, 7, 8, and 9) the NIP was fitted with a filter wheel containing filters matching the flight set. The incident irradiance is calculated using the measured irradiance and the appropriate filter factor for the particular filter.

The ERB Reference Sensor Model (RSM), which is a duplicate of the flight instruments relative to the solar channels, has been employed as a transfer and checking device throughout the Nimbus 6 and Nimbus 7 calibration program. All vacuum calibrations of the Nimbus 6 and 7 ERB solar channels could be referenced through the RSM as well as many of the calibrations performed at atmospheric pressure.

In-flight

In-flight calibration for the solar channels does not exist, except for channel 10c whose cavity is heated by a precision resistance heater. Accurate monitoring of the voltage and current of the heater as well as the detector response yields the calibration sensitivity. This led to very precise determinations of the total solar irradiance (Hickey, et al., 1981). All thermopile channels are equipped with the same heaters which are used during pre-launch activities to check whether the channels are functioning properly. The heaters are used as a rough check in the analysis of operational data. These channels are also equipped with an electrical calibration which inserts a precision voltage staircase at the input to the entire signal conditioning stream. While the electronic calibration cannot be used to infer changes in the sensor or optics characteristics, it insures the prevention of misinterpretation of electronic measurements. Analysis of the electronic calibration data has yielded no abnormalities. Channels 1 through 3 can be directly compared with channel 10c to assess their in-flight calibration. In addition, the degradation of channel 2 is checked by the occasional exposure of its duplicate (channel 1), which is normally shuttered.

The degradation with time of the solar channels 1 through 9 is depicted in Figure 2-3 for the first 8 months of flight. Particular attention should be given to channels 6 through 9 which contain the interference filters. Their curves show that a high rate of degradation occurred during the first two months followed by a short period of relative stability. After this the channels reversed the earlier trend and began to recover. After a little over four months in orbit, three of the channels completely recovered while the remaining one (channel 7) almost recovered.

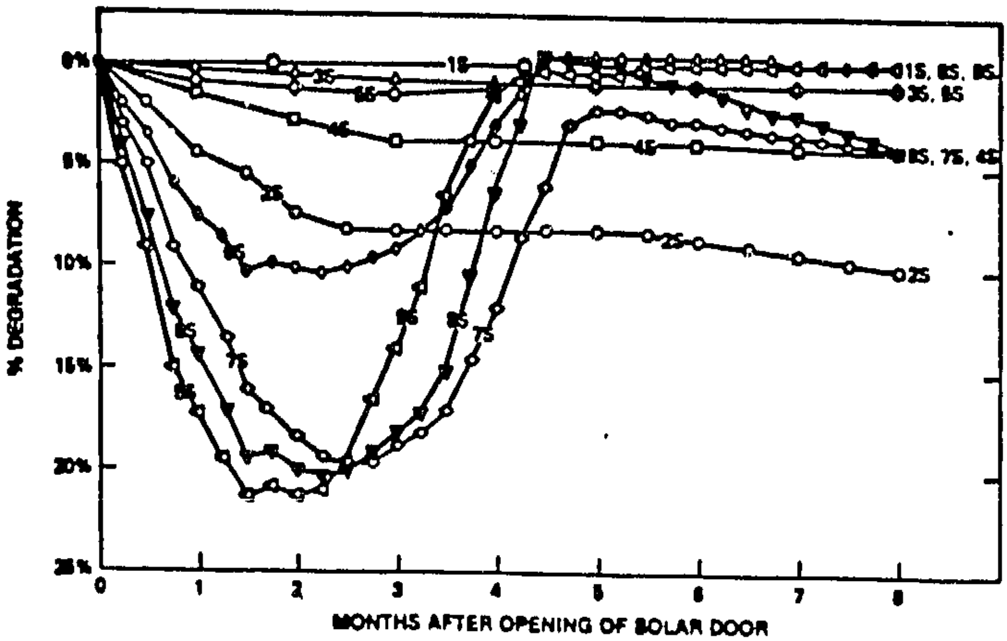


Figure 2-3: Percent Degradations Of Solar Channels. (Jacobowitz, et al., 1984).

2.3.3 ERB Solar Data for SEFDT

Initially only a preliminary data set of the total solar irradiance called the 'engineering level' data was available. Other solar parameters were obtained from the ERB Master Archival Tapes (MATS). After preliminary review of the processed flight data from the Nimbus-7 ERB, certain changes were made in the processing algorithms and the solar data was reprocessed. This new high-quality data set for the ERB solar channels (plus earth flux channel data) were made available on a set of special digital tapes referred to as the Solar-Earth Flux Data Tapes (SEFDT). A user's guide for the SEFDT data has recently been made available (Ray, et al., 1984).

2.3.3.1 ERB Solar Channel Algorithms

The algorithms used to determine the solar irradiance from the 10 ERB solar channels are as follows (Ray, et al., 1984):

The Temperature Sensitivity Correction Factor

$$S(T) = S_V (1 + A (T - L)) \qquad (1)$$

where

S_V = Channel sensitivity in a vacuum at 25° C (22°C for channel 10c only) in counts per watts/m^2 (see Table 2-1).

A = Temperature sensitivity at 25°C (22°C for channel 10c only) in $^{\circ}C^{-1}$ (see Table 2-1)

T = Temperature in °C.

L = Reference Temperature:
Channels 1-9: 25°C
Channels 10c: 22°

The uncorrected Net Solar Irradiance:

$$R = \left[V_0 - \tfrac{1}{2}(V_- + V_+)\right] / S(T) \qquad (2)$$

TABLE 2-1

CHANNEL COEFFICIENTS

CHANNEL	S_V	A
1	1.299	0.0007
2	1.275	0.0008
3	1.214	0.0008
4	1.719	0.0007
5	2.424	0.0006
6	6.931	0.0007
7	9.588	0.0003
8	12.715	-0.0004
9	30.170	-0.0011
10c	1.3013	0.000524

PRECEDING PAGE BLANK NOT FILMED

PAGE 11 INTENTIONALLY BLANK

where

V_o	=	Solar channel detector output in counts at T_o
V_-	=	Solar channel detector output in counts at T_o - 13 minutes
V_+	=	Solar channel detector output in counts at T_o + 13 minutes
S(T)	=	Temperature sensitivity correction factor

For the ERB channel 10C, a self-calibrating cavity thermopile for equations used to convert counts to irradiance are:

$$H_{10C} = E_m \, C_f \, / \, S_p(T) \tag{2}$$

Where

$$E_m = E_{os} - \frac{E(-13) + E(+13)}{2} \tag{3}$$

$$S_p(T) = S_o + S\,(T_H - 22^o) \tag{4}$$

$H_{10}C$	=	channel 10C irradiance in W/m^2
C_f	=	channel 10C correction factor for aperature area and nonequivalence (M^{-2})
Eos	=	average channel 10C on-sun counts
E($\pm$ 13)	=	average channel 10C counts at $\pm$ 13 minutes from on-sum time
S_o	=	power sensitivity zero level (C/W)
S_p	=	power sensitivity slope (C/W^{o}C)
TH	=	channel 10C heat sink temperature (^{o}C)

Adjustment of Channel 10c for Reflectance.

(Note: This correction is applied to Channel 10c only).

$R_{10c} = U_{10c} * 0.998$

U_{10c} = Unadjusted Channel 10c Net Solar Irradiance

R_{10c} = Adjusted Channel 10c Net Solar Irradiance

Note: At this point, all the net solar irradiances must be corrected for Sun-Earth distance.

Correction of Net Solar Irradiance for Sun-Earth Distance.

$$NSR = R * R_{SE}^2 \tag{6}$$

R - Uncorrected Net Solar Irradiance

R_{SE} - Instantaneous Sun-Earth Distance in Astronomical units. Note that the average Sun-Earth distance in astronomical units is 1.0.

NSR is the final corrected Net Solar Irradiance that appears in the SEFDT Solar Orbital Summary Records.

This is the value for the irradiance that also appears in the orbital and daily mean files of the ESAT.

In addition a separate cosine-corrected channel 10c value is given in the ESAT orbital and daily mean files. This is a correction for the off-axis angle ($\gamma_{off-axis}$). The off-axis angle measures the angular deviation of the pointing vector of the solar channel assembly from the position of the Sun. The gamma angle (γ) is adjusted by ground commands in order to account for changes in the DSAS (solar azimuth) angle. The off-axis angle as used in the SEFDT is defined as (Ray, et al., 1984):

$$\gamma_{\text{off-axis}} = \gamma + 0.1 * \beta_{DSAS}$$

This angle is then used by the Eppley Laboratories to obtain the cosine-corrected channel 10c irradiance:

$$\text{NSR}^*(10c) = \text{NSR}(10c)/\cos\,(\gamma_{\text{off-axis}})$$

2.3.3.2 Time of Minimum Solar Elevation

The time of minimum solar elevation is defined to be the relative minimum of the ERB solar channel 5 counts for each orbit as shown in figure 2-4. Channel 5 is the solar alignment indicator because it suffers the least degradation of those channels (1, 2, 4 and 5) that have the proper angular response function.

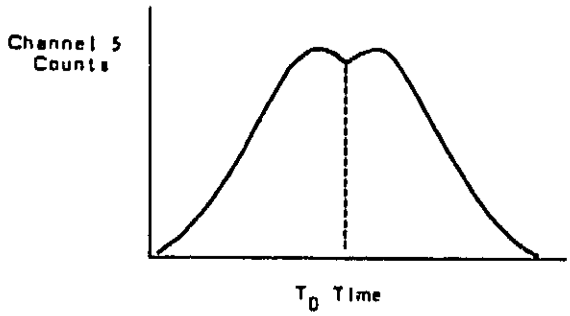


Figure 2-4. Time of minimum solar elevation

The time of minimum solar elevation was labelled T_O for all of the ten solar channels.

The algorithm for determining T_O was a 3-step process:

1) Search the Channel 5 counts for the orbit and tabulate the occurence of counts between 1000 and 2000. Counts greater than 1000 indicate sun is in the field of view.

2) Find, in the table, the smallest count value occurring more than four times (occurring n times).

3) T_O is the time associated with the median of the possible smallest count values (n/2). (i.e., if the smallest count values occurs 8 times, T_O will be the time associated with the fourth occurance).

If no time of minimum solar elevation was found, T_O was set to the southern terminator time for selection of solar data records.

2.4 Solar Activity Indicators

The ERB solar channels are well designed to measure fluctuations in the solar irradiance at several spectral bands. Preliminary studies of variations in solar radiance with channel 10c have shown that sensor to be quite stable and well behaved over the first year of measurement (Hickey, et al., 1980). Over longer periods (first 3 ERB years), measurements of the solar irradiance have revealed a downward trend which may be due to actual solar irradiance variability rather than instrumental degradations (Hickey, et al., 1983; Smith, et al., 1983a).

It has been theorized that solar activity (indicated by sunspots, plage regions, etc.) may cause changes in the solar irradiance (Foukal, et al., 1977). The high quality ERB solar measurements constitute a time series that can be matched with solar activity indicators. Preliminary correlative analysis with solar activity indicators (sunspot numbers and 2800 MHz solar flux) seem to match dip in ERB solar irradiance measurement with peak in solar activity as shown in Figure 2-5 for the five-year channel 10c data. This has been discussed by Hickey et al., (1982), Hickey and Alton (1983) and Smith et al., 1983a,b). Data from the SEFDT was used to construct this figure. Other studies with a similar cavity radiometer (ACRIM) on the Solar Maximum Mission (SMM) show similar correlations (Willson, et al., 1981). The nature of these variations in the solar irradiance is reasoned to be attributed to the equatorial solar rotation cycle, a long-term (11-year) solar cycle and a long-term solar cycle not directly related to solar activity (Smith, et al., 1983).

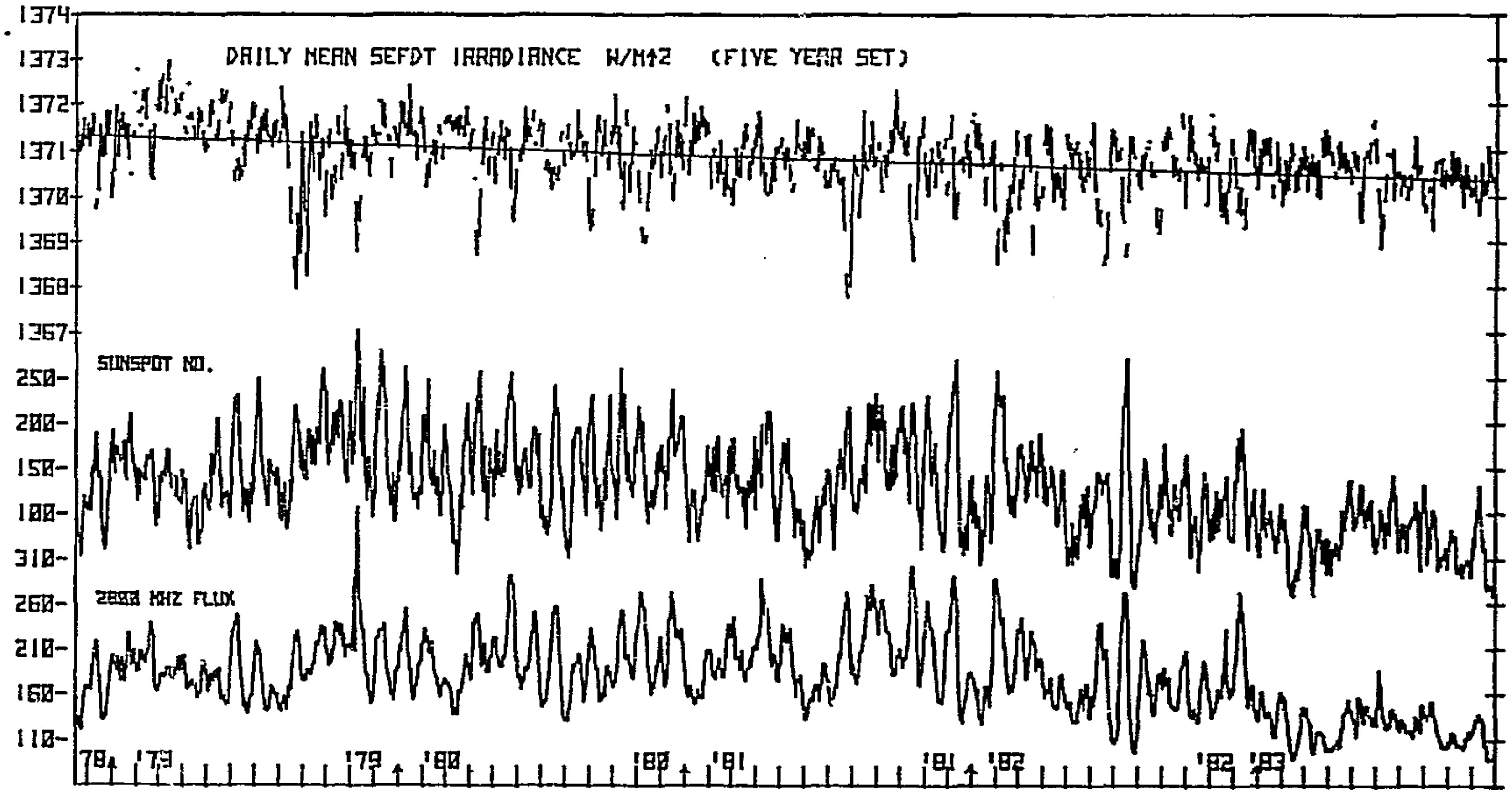


Figure 2-5: Channel 10C Irradiance vs. Solar Activity Indicators.
(Hickey,J.R., Eppley Labs, 1984)

3.0 DESCRIPTION OF ESAT CONTENTS

3.1 Origin of ESAT Data

A complete and high precision data set for the Nimbus-7 ERB solar channels was made available on a set of special digital tapes referred to as the Solar-Earth Flux Data Tapes (SEFDT). The ERB solar data on these tapes were used by Eppley Labs to derive the solar data for the ESAT. Appendix B shows the SEFDT tapes used to generate the ESAT data. With the exception of channel 10c (see section 3.3), all of the ERB solar channel data on the ESAT are the same as on the SEFDT.

3.2 Differences between ESAT and SEFDT

The purpose of ESAT was to have a complete ERB solar data set free of the Earth-flux data and other information on the SEFDT that is not used by the solar community. Although the solar data used to generate the ESAT data set was derived from the SEFDTs, there are some differences between the two data sets.

- o Solar data corrected or deleted for bad orbits and/or missing or incorrect data (see section 3.3)

- o Daily mean and statistics derived from 'cleaned' orbital information are included on the ESAT.

- o Calculated off-axis angle, mission day and earth-sun distance are included on ESAT.

- o Cosine-corrected channel 10c (see section 3.3) included on ESAT.

- o ESAT includes solar activity indicators.

3.3 Corrections to SEFDT Data

The solar data for the ESAT represents a higher order data set than the already high quality SEFDT data. For the ESAT data set, orbits and/or variables that are incorrect or beyond certain limits were deleted or corrected by Eppley Laboratories from the SEFDT orbital summary records. Limit criteria were based on the off-axis angle and temperatures

of channels 3 and 10c. If the off-axis angle exceeded 3.1° then those orbits were deleted. If the temperature of either channel 3 or channel 10c fell below 18°C then those orbits were deleted. The daily mean solar data and statistics were generated after screening of the orbital data.

The ESAT data set includes a cosine-corrected channel 10c. This correction is a first-order correction performed by Eppley Labs and is simply the cosine of the off-axis angle applied to the mean channel 10c irradiance calculated in the SEFDT.

The ESAT data set also includes the calculated mission day (Mission day 1 is Nov. 16, 1978) and the calculated off-axis angle (solar azimuth + gamma angle).

3.4 Origin of Solar Activity Indicators

The solar activity indicators defined on the ESAT were derived from the NOAA/National Geophysical Data Center (NGDC) Solar Geophysical Data Reports (SGD) (NOAA/NGDC, 1982). Sunspot and solar flux data, initially derived from the SGD's were obtained from Eppley Labs. Solar plage data were obtained from Dr. Ken Schatten at NASA/GSFC and were orginially obtained from NOAA/NGDC World Data Center-A and published in the SGD. Daily calcium plage index and geomagnetic index were obtained directly from the SGD prompt reports.

A detailed description of the solar activity indicators are as follows:

Zurich Relative Sunspot Numbers. A measure of visible daily solar activity. This number is derived from several observatories and combines the number of single spots and groups of spots on the solar disk. The formula is:

$$R_z = k(10g + s)$$

Where

$10g$ = number of spots and groups (weighted by 10)

s = total number of distinct single parts

k = factor that depends on the observer and is used to convert measure from the original Wolf sunspot scale.

The Zurich Relative Sunspot Numbers comprise a complete daily record of solar activity for the five year period from 16 November 1978 through 31 October 1983.

Ottawa 2800 MHz Solar Flux. A measure of daily radio solar activity. These measurements are the daily observations of the 2800 MHz radio emissions that originate from the solar disk and from any active region. Measurements are made at the Algonquin Radio Observatory (ARO) of the National Research Council of Canada with a 1.8 m diameter reflector. Measurements are in flux units of $10^{-22} Wm^{-2} Hz^{-1}$.

The Ottawa 2800 MHz Solar Flux comprise a complete daily record of solar activity for the five year period from 16 November 1978 through 31 October 1983.

Daily Calcium Plage Index. An index of solar activity based on the solar plage area and coordinates. The index as given by W. R. Swartz and modified in the SGD is:

$$C_A II_{index} = [\sum_i I_i A_i \cos\theta_i \cos\phi_i]$$

where the summation includes all plages visible on that day,

I_i = intensity of plage i

A_i = corrected area of plage i in millionths of solar hemisphere

θ_i = central meridian distance of plage i in degrees

ϕ_i = latitude of plage i

The Daily Calcium Plage Index data is available on a daily basis from 16 November 1978 through August 1982. Missing data or where no observations were made are defined as 0.

Geomagnetic Index. A daily index of magnetic activity due to solar events recorded on a linear scale. The daily Ap series is used and is an average of 8 values of an intermediate 3-hourly index.

The Geomagnetic Ap Series Index is available on a daily basis from 16 November 1978 through December 1982. Missing data are defined as 0.

Solar Plage Data. Plage regions are the bright areas on the solar disk (also called faculae) sometimes preceeding the appearence of spots. Seven parameters describe the plage region. These were derived from the SGD:

> McMath-Hale Region Number. This is the active region number assigned in order of appearence on the solar disk. More than one region number can appear on a day.
>
> Central Meridian Passage Data. The date of central meridian passage of the region, at 12^hUT and corrected for whether noon or after noon.
>
> Latitude. The latitude of the region center of mass, north or south of solar equator. Negative latitudes are south.
>
> Central Meridian Distance. Distance of the region center of mass east or west of the central meridian at 12^hUT. Distance is in degrees measured to the West 0-360°.
>
> Carrington Longitude. An internationally agreed zero meridian. This is the central meridian that passed through the apparent center of the disk on 1 January 1854 at 12^hUT. The Carrington longitude is measured in degrees to the west 0-360°. The zero meridian is established on completion of a solar rotational period with mean duration of 27.2753 days.

Area. The corrected area (corrected for distance from the center of the solar disk) in millionths of the solar hemisphere.

Intensity. The intensity of the plage region on a scale of 1 (very faint) to 5 (very bright).

Solar plage data is available from 16 November 1978 through June 1982. The number of plage regions per day is noted on the ESAT tape in order to read the proper number of plage region records. If no observations were made then the solar plage parameters are 0.

3.5 ERB Solar Channel Data

The ERB solar channel data, derived from the SEFDTs, are comprised of two parts: the orbital solar data and the daily mean solar data which consists of the mean, standard deviation, minimum and maximum. The daily mean data was derived by Eppley Labs from the filtered orbital data using the Statistical Analysis System (SAS) software package.

The contents of the orbital ERB solar data is as follows:

- Orbit number, year, day of year
- Solar azimuth and elevation
- Instrument status word (ISW)
- Gamma angle
- Earth-sun distance (Least Significant Bit, Most Significant Bit)
- Channel 3 and Channel 10c temperatures
- Channels 1-10c irradiances
- Southern terminator crossing time
- Mission day since Nov. 16, 1978
- Off-axis angle
- Cosine corrected channel 10c irradiance

The contents of the daily mean ERB solar data (which includes the mean, standard deviation, minimum and maximum and number of orbits of each parameter) is as follows:

- o Orbit number, year, day of year
- o Solar azimuth and elevation
- o Gamma angle
- o Channel 3 and 10c temperatures
- o Channel 1-10c irradiances
- o Mission day since Nov. 16, 1978
- o Off-axis angle
- o Cosine corrected channel 10c irradiance
- o Earth-Sun distance

3.6 Solar Activity Indicators

The solar activity indicators on the ESAT are not the most comprehensive but do constitute a long time series of the more common and useful indicators.

A description of the contents of the solar activity data set is as follows:

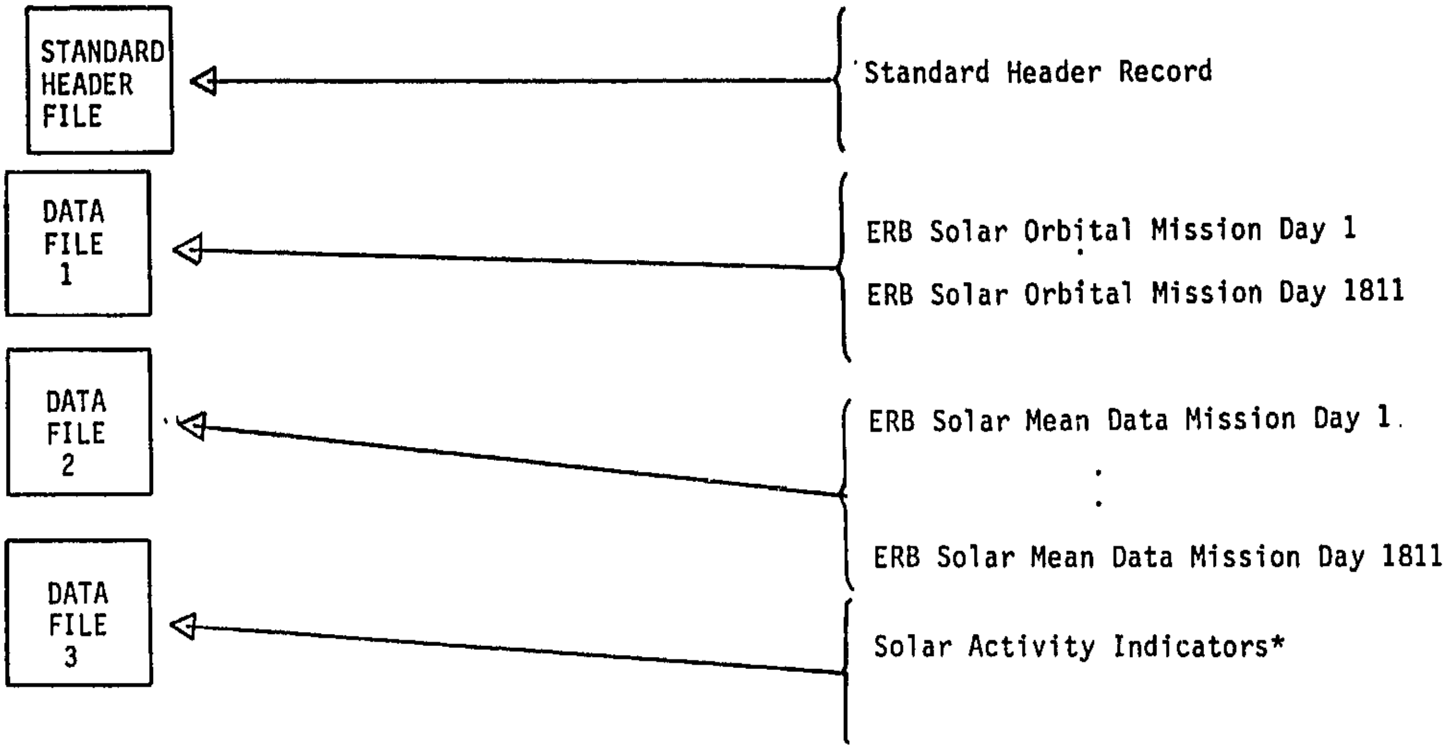
- o Zurich Relative Sunspot Number (daily)
- o Ottawa ARO 2800 MHz solar flux (daily)
- o Daily Calcium Plage Index
- o Geomagnetic Index (Ap)
- o Solar plage regions including:
  - o McMath-Hale region number
  - o coordinates including CM and Carrington longitude
  - o corrected area
  - o Intensity

3.7 Missing Data

Missing data in the orbital and mean datasets are flagged with -9999. Data gaps and ERB off days in the mean data are flagged with -9999. Gaps in the solar activity records are not flagged but are simply missing as indicated by 0.

3.8 ESAT Tape Structure

The ESAT has three data files. Data File 1 contains the five-year orbital data set, Data File 2 contains the daily mean five-year data set, and Data File 3 contains the solar activity data. The physical structure of the tape is shown in figure 3-1.



*Not all solar activity indicators are available for all five years.

Figure 3-1: Physical Structure of ESAT Tape

4.0 PHYSICAL STRUCTURE OF ESAT TAPE

4.1 Tape Organization

The ESAT Tape is a 9-track, unlabeled, 1600 BPI IBM 370/3081 compatible tape. The first file contains the Nimbus Observation Processing System (NOPS) Standard Header. The second file contains the ERB solar orbital data for five years. The third file contains the ERB solar daily mean data for five years. The fourth file contains the solar activity indicator data.

The NOPS Standard Header file is described in Appendix A.

4.2 Tape and File Specifications

Tape Specifications: 1600 BPI, 9-track non-labeled tape

File Specifications:

	Header File	Data File 1	Data File 2	Data File 3
File Location	1	2	3	4
Record Length (bytes)	630	84[1]	376[2]	56[3]
Record Format	unblocked	U	U	U
Data Type	EBCDIC	binary	binary	binary
Rec ID No	none	100	200	300

[1] 84 bytes per observations x 18466 observations = 1,551,144 bytes
[2] 376 bytes per day x 1811 days = 680,936 bytes
[3] 56 bytes per observation x 1811 days = 101,416 bytes minimum
The total number of bytes for the solar actvity data set 729,036 bytes.

4.3 ESAT Data File Specifications

The following Tables (4.1, 4.2, and 4.3) and accompanying information describe in detail the word location of each data item in each data file. A description of each data item is also included. Appendix C includes the scale factors used to generate the ESAT data set.

TABLE 4-1

ESAT ORBITAL DATA
RECORD FORMAT

WORDS	MSB 32	LSB 0	BITS
1	RECORD NUMBER	RECORD ID	32
2	ORBIT NO.	SPARE	64
3	YEAR	DAY OF YEAR	96
4	SOLAR AZIMUTH	SOLAR ELEVATION	128
5	INSTRUMENT STATUS WORD	GAMMA ANGLE	160
6	EARTH-SUN DISTANCE (MSB)	EARTH-SUN DISTANCE (LSB)	192
7	CHANNEL 3 TEMPERATURE		224
8	CHANNEL 10 c TEMPERATURE		256
9 - 18	CHANNEL 1-10c IRRADIANCE		576
19	SOUTH TERM. (HRS/MIN)	SOUTH TERM. (SECS.)	608
20	MISSION DAY	OFF-AXIS ANGLE	640
21	COSINE-CORRECTED CHANNEL 10c IRRADIANCES		672

WORDS 1-6 AND 19-20 ARE IBM INTEGER*2 FORMAT
WORDS 7-8 AND 21 ARE IBM INTEGER*4 FORMAT

TABLE 4-2

ESAT DAILY MEAN DATA
RECORD FORMAT

WORDS	MSB 32	LSB 0	BITS
1	RECORD NUMBER	RECORD ID	32
2 - 6	ORBIT NO. (MEAN, STD. DEV., MIN., MAX., NO)		192
7	YEAR		224
8	DAY OF YEAR		256
9 - 13	SOLAR AZIMUTH (MEAN, STD. DEV., MIN., MAX.,NO.)		416
14 - 18	SOLAR ELEVATION (MEAN, STD. DEV., MIN., MAX., NO.)		576
19 - 23	GAMMA ANGLE (MEAN, STD. DEV., MIN., MAX., NO.)		736
24 - 28	CHANNEL 3 TEMPERATURE (MEAN, STD. DEV., MIN., MAX., NO.)		896
29 - 33	CHANNEL 10c TEMPERATURE (MEAN, STD. DEV., MIN., MAX., NO.)		1056
34 - 83	CHANNEL 1-10c IRRADIANCE (MEAN, STD. DEV., MIN., MAX., NO.)		2656
84	MISSION DAY		2688
85 - 89	OFF-AXIS ANGLE (MEAN, STD. DEV., MIN., MAX., NO.)		2848
90 - 94	COSINE-CORRECTED CHANNEL 10c IRRADIANCE (MEAN, STD. DEV., MIN., MAX., NO.)		3008

WORD 1 IS IBM INTEGER*2 FORMAT
WORDS 2-99 ARE IBM INTEGER*4 FORMAT

TABLE 4-3

ESAT SOLAR ACTIVITY DATA
RECORD FORMAT

WORDS	MSB 32	LSB 0	BITS
1	RECORD NO.	RECORD ID.	32
2	YEAR	DAY OF YEAR	64
3	NUMBER OF PLAGE OBSERVATIONS		96
4	ZURICH SUNSPOT NUMBER		128
5	2800 MHz SOLAR FLUX		160
6	DAILY CALCIUM PLAGE INDEX		192
7	GEOMAGNETIC INDEX, Ap SERIES		224
8 - 14	SOLAR PLAGE REGION DATA		448*

WORDS 1-2 ARE IBM INTEGER*2 FORMAT
WORDS 3-14 ARE IBM INTEGER*4 FORMAT

*MINIMUM OF 448 BITS, DEPENDS ON NUMBER OF PLAGE REGIONS PER DAY.

ERB SOLAR ANALYSIS TAPE - DATA FILE 1
ORBITAL ITEM DESCRIPTIONS

ITEM NO.	WORD	TYPE	DETAILED DESCRIPTION OF DATA ITEMS
1	1	I*2	RECORD NO. - Number of this record in this file.
2	1	I*2	RECORD ID. - Record identification number. 100 = Orbital File
3	2	I*2	ORBIT NO. - Data orbit number
4	2	-	Spare (-9999)
4	3	I*2	YEAR - 4 digit year
5	3	I*2	DAY OF YEAR - Day number
6	4	I*2	SOLAR AZIMUTH - Azimuth of sun relative to the S/C axes. Value in degrees (-180 to +180). Same as DSAS alpha angle, scaled by 10.
7	4	I*2	SOLAR ELEVATION - Elevation of sun relative to the S/C axes. Value in degrees (-180 to +180). Same as DSAS beta angle, scaled by 10.
8	5	I*2	INSTRUMENT STATUS WORD - Determined from VIP MF.

Units Decimal Digit (indicates position of scanhead)

0 = Scan mode
1 = Nadir position
2 = Space position
3 = LW check position
4 = SW check position
9 = Transition mode

Tens Decimal Digit (indicates status of shutters, chs. 1, 11, & 12)

0 = Reference chs. CLOSED, Ch. 12 OPEN
1 = Reference chs. CLOSED, Ch. 12 CLOSED
2 = Reference chs. OPEN, Ch. 12 OPEN
3 = Reference chs. OPEN. Ch. 12 CLOSED
9 = Status unknown

Hundreds Decimal Digit (indicates status of Ch. 12 FOV)

0 = Ch. 12 FOV Wide
1 = Ch. 12 FOV narrow
9 = Status Unknown

ITEM NO.	WORD	TYPE	DETAILED DESCRIPTION OF DATA ITEMS
			Thousands Decimal Digit (indicates status of El. Cal., and Go/No go heater) 0 = Go/No go heater OFF, El. Cal. OFF 1 = Go/No go heater OFF, El. Cal. ON 2 = Go/No go heater ON, El. Cal. OFF 9 = Status unknown
9	5	I*2	GAMMA ANGLE - Solar channel subassembly position at Middle of MF.
10	6	I*2	EARTH-SUN DISTANCE - MSB Earth-Sun distance.
11	6	I*2	EARTH-SUN DISTANCE - LSB Earth-Sun distance.
12	7	I*4	CHANNEL 3 TEMPERATURE - Temperature in degrees centigrade, scaled by 10.
13	8	I*4	CHANNEL 10c TEMPERATURE - Temperature in degrees centigrade, scaled by 10.
14-24	9-18	I*4	CHANNEL 1-10c IRRADIANCES - Channels 1-10c irradiances in W/m^2. Scale factor for channels 1-5, 10c is 10; channels 6-9 is 100.
25	19	I*2	SOUTHERN TERMINATOR (HRS/MIN) - GMT hours/minutes of southern terminator crossing.
26	19	I*2	SOUTHERN TERMINATOR (SECS) - GMT seconds of southern terminator crossing.
27	20	I*2	MISSION DAY - Mission day number starting with 1 on 16 November 1978.
28	20	I*2	OFF-AXIS ANGLE - Calculated sum of solar azimuth and gamma angles.
29	21	I*4	COSINE-CORRECTED CHANNEL 10c - channel 10c irradiance corrected with cosine of off-axis angle, scaled by 10.

ERB SOLAR ANALYSIS TAPE
ERB DAILY MEAN ITEM DESCRIPTIONS - DATA FILE 2

ITEM NO.	WORD	TYPE	DETAILED DESCRIPTION OF DATA ITEMS
1	1	I*2	RECORD NUMBER - The number of this record in this file.
2	1	I*2	RECORD ID - The record identification for this file. 200 = Daily Mean
3	2-6	I*4	ORBIT NUMBER - Data Orbit number Mean - scaled by 1000 Std. Dev. - scaled by 100,000 MINIMUM - minimum orbit number MAXIMUM - maximum orbit number NUMBER - Number of orbits to calculate mean
4	7	I*4	YEAR - 4-digit year.
5	8	I*4	DAY OF YEAR - Day number
6	9-13	I*4	SOLAR AZIMUTH - Azimuth of sun relative to S/C axes. Value in degrees (-180 to +180). MEAN - scaled by 10,000 Std. Dev. - scaled by 1,000,000 MINIMUN - Minimum solar Azimuth, scaled by 10. MAXIMUM - Maximum solar azimuth, scaled by 10 NUMBER - Number to calculate mean
7	14-18	I*4	SOLAR ELEVATION - Elevation of sun relative to S/C axes. Value in degrees (-180 to +180). MEAN - scaled by 10,000 STD. DEV. - scaled 100,000 MINIMUM - minimum solar elevation, scaled by 10. MAXIMUM - Maximum solar elevation, scaled by 10. NUMBER - Number to calculate mean.
8	19-23	I*4	GAMMA ANGLE - Solar channel subassembly position at middle of MF. MEAN - scaled by 100,000 STD. DEV. - scaled by 100,000 MINIMUM - minimum gamma angle MAXIMUM - maximum gamma angle NUMBER - number to calculate mean gamma angle

ITEM NO.	WORD	TYPE	DETAILED DESCRIPTION OF DATA ITEMS
9	24-28	I*4	CHANNEL 3 TEMPERATURE - Temperature of channel 3 in degrees centigrade. MEAN - scaled by 10,000 STD. DEV. - scaled by 100,000 MINIMUM - minimum channel 3 temperature, scaled by 10. MAXIMUM - Maximum channel 3 temperature, scaled by 10. NUMBER - Number to calculate mean channel 3 temperature
10	29-33	I*4	CHANNEL 10c TEMPERATURE - Temperature of channel 10c in degrees centigrade. MEAN - scaled by 10,000 STD. DEV. - scaled by 100,000 MINIMUM - Minimum channel 10c temperature, scaled by 10. MAXIMUM - Maximum channel 10c temperature, scaled by 10. Number - Number to calculate mean channel 10c temperature.
11	34-83	I*4	IRRADIANCES - channels 1-10c irradiances in W/m^2. MEAN - channel 1 scaled by 10; channels 2-3, 10c scaled by 100; channels 4-9 scaled by 1000. STD. DEV. - channels 1-2, 4-6 scaled by 100,000. channels 3, 7-10c scaled by 1,000,000. MINIMUM - minimum channels 1-10c irradiances. Channels 1-5 scaled by 10; channels 6-10c scaled by 100. MAXIMUM - Maximum channels 1-10c irradiances. Channels 1-5, 10c scaled by 10; channels 6-9 scaled by 100. NUMBER - Number to calculate mean channels 1-10c irradiances.
12	84	I*4	MISSION DAY - Day number starting with 1 on 16 November 1978.
13	85-89	I*4	OFF-AXIS ANGLE - calculated sum of solar azimuth and gamma angle. MEAN - scaled by 10,000 STD. DEV. - scaled by 100,000 MINIMUM - minimum off-axis angle, scaled by 10. MAXIMUM - Maximum off-axis angle, scaled by 10. NUMBER - number to calculate mean off-axis angle.

ITEM NO.	WORD	TYPE	DETAILED DESCRIPTION OF DATA ITEMS
14	90-94	I*4	COSINE-CORRECTED CHANNEL 10c - Channel 10c irradiance corrected by cosine of off-axis angle. MEAN - scaled by 100 STD. DEV. - scaled by 100,000 MINIMUM - minimum corrected channel 10c irradiance MAXIMUM - maximum corrected channel 10c irradiance NUMBER - Number to calculate mean corrected channel 10c irradiance.

ERB SOLAR ANALYSIS TAPE
SOLAR ACTIVITY INDICATORS - DATA FILE 3

ITEM NO.	WORD	TYPE	DETAILED DESCRIPTION OF DATA ITEMS
1	1	I*2	RECORD NO. - the number of this record in this file.
2	1	I*2	RECORD ID - the record identification of this file. Solar Activity = 300.
3	2	I*2	YEAR - 4 digit year
4	2	I*2	DAY OF YEAR - Day number
5	3	I*4	PLAGE NO. - Number of plage regions for this day. If 0 then no observations are available for this day.
6	4	I*4	ZURICH RELATIVE SUNSPOT NUMBERS - daily index of solar activity. Daily sunspot numbers.
7	5	I*4	OTTAWA 2800 MHz SOLAR FLUX - daily index of solar activity. Daily radio emissions from active regions in $10^{-22} Wm^{-2} Hz^{-1}$ scaled by 10.
8	6	I*4	DAILY CALCIUM PLAGE INDEX - summation of all plages visible on solar disk corrected for distance from center.
9	7	I*4	GEOMAGNETIC INDEX - Geomagnetic Ap series measure of magnetic activity due to solar activity. Scaled by 10.
10	8-14	I*4	SOLAR PLAGE REGION DATA - consists of following seven parameters. MCMATH-HALE REGION NUMBER - number assigned to region of solar activity. CENTRAL MERIDIAN PASSAGE DATE - Central meridian at 12^hUT at time of observation. Scaled by 10. LATITUDE - Latitude of region north or south of solar equator. South latitudes are negative. CENTRAL MERIDIAN DISTANCE - distance east or west of central meridian of region. Measured 0-360° to the west. CARRINGTON LONGITUDE - central meridian that passed through solar disk on 1 January 1854 at 12^hUT. Measured 0-360° to the west. AREA - area of region corrected for distance from the center of the solar disk in millionths of solar hemisphere. INTENSITY - Intensity of region on a scale of 1 = faint to 5 = very bright, scaled by 10. Note: More than one solar plage region per day may be visible.

5.0 DAILY MEAN SOLAR IRRADIANCES

The daily mean solar irradiances as measured by each of the 10 ERB solar channels were plotted for the five years from 16 Nov 1978 through 31 Oct 1983 including data gaps as shown in figures 5-1 to 5-10.

No correction has been made in this data set for sensor degradation. Only channel 10c is self-calibrating and the calibration data shows no visible sign of degradation in this channel. Comparison of the 9 other solar channels to channel 10c shows a visible history of channel sensitivity changes in all 9 channels. This makes the analysis of this data more complicated than that of channel 10c. Hickey et al., (1981) and Smith et al., (1983a) have used the spectral channels to examine spectral irradiance changes connected to the solar rotation period during active sun periods. Additional studies of ERB spectral irradiances are planned by the ERB experiment team.

As discussed in Section 2.3.1, all of the channels except channel 10c were affected by degradation and recovery events immediately after launch. The ultraviolet channels, (6-9) were the most severely affected and show significant recovery, although channels 6 and 9 show a trend toward increasing solar irradiance. This degradation and recovery process was explained in a paper by Predmore, et al., (1982). The plots shown in Figures 5-1 through 5-10 show ERB solar channel measurements that were screened for bad orbits, etc. from the SEFDTs as discussed in Section 3.3. The following preliminary analysis describes the degradation and recovery characteristics of each channel:

Channel 1: Mostly shuttered and opened periodically, but does show a constant downward trend. After initial degradation and recovery, Channel 1 shows 3% (0.6% per year) degradation from 1 Mar 1979 through 31 Oct 1983.

Channel 2: Initial degradation from 16 Nov 1978 through 30 Nov 1979. Channel 2 shows ~5.2% degradation (~1.3% per year) from 1 Dec 1979 through 31 Oct 1983.

Channel 3: Initial degradation from 16 Nov 1978 through 30 Apr 1979. Channel 3 shows an overall degradation 0.36% (~.08% per year) from 1 May 1979 through 31 Oct 1983. However, there is a period of increasing irradiance from 31 Dec 1982 through 31 Oct 1983 of 0.3%. Therefore, the degradation from 1 May 1979 through 31 Dec 1982 is 0.7% (~0.18% per year).

Channel 4: Initial degradation from 16 Nov 1978 through 30 Nov 1979. Channel 4 shows ~3% degradation (~0.7% per year) from 1 Dec 1979 through 31 Oct 1983.

Channel 5: Shows a complicated behavior throughout the five year period. Initial rapid degradation from 16 Nov 1978 to mid-January 1979 followed by recovery by early May 1979 and another degradation period to mid-August 1979. Channel 5 shows a recovery by 1 Dec 1979 and an overall degradation to 31 Oct 1983 of ~1.3% (~0.3% per year). There is a period between 1 Jan 1981 and 1 Feb 1981 of very rapid drop in irradiance of ~1.2% in 1 month.

Channel 6: Initial rapid degradation and recovery from 16 Nov 1978 through 31 Mar 1979. Channel 6 shows ~1.4% increase in irradiance (~0.3% per year) from 1 Apr 1979 through 31 Oct 1983.

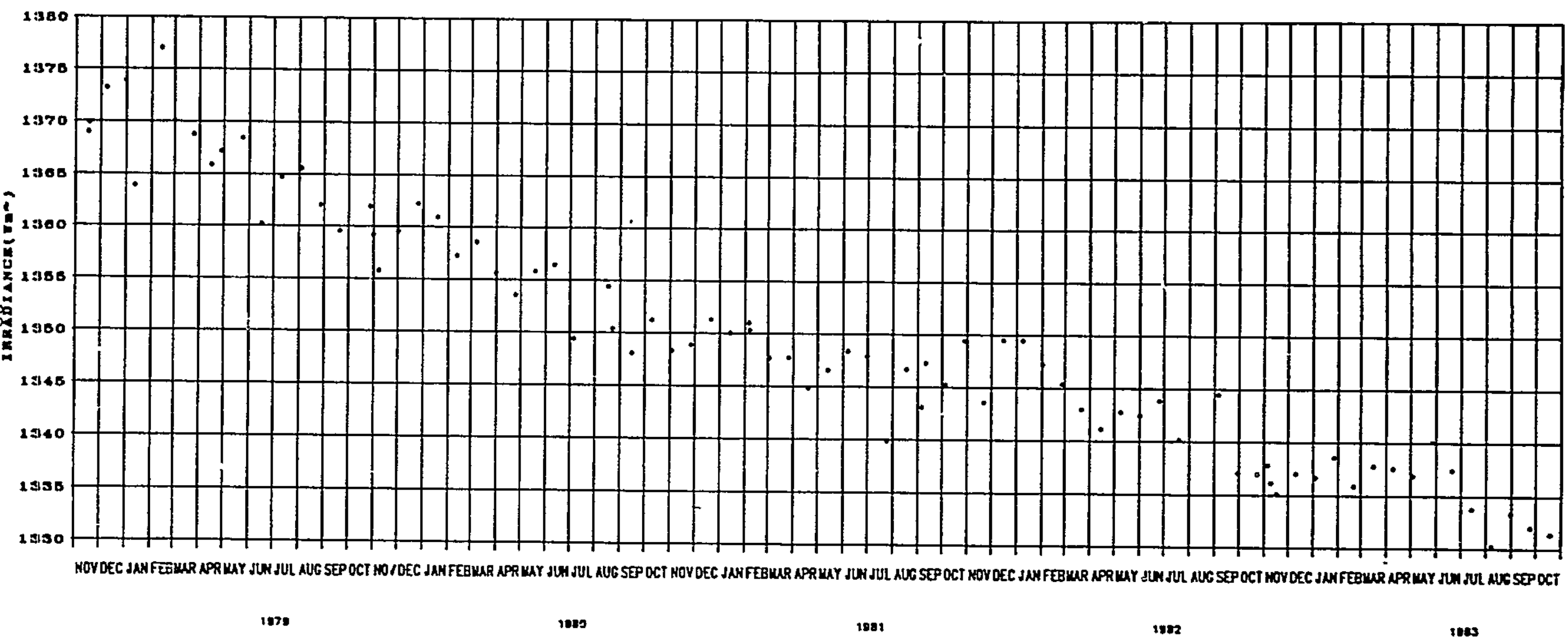
Channel 7: Initial rapid degradation and recovery from 16 Nov 1978 through 31 Mar 1979. Channel 7 shows a more marked degradation of ~18.5% (~4.1% per year) from 1 Apr 1979 through 31 Oct 1973.

Channel 8: Initial rapid degradation and recovery from 16 Nov 1978 through 31 May 1979. Channel 8 shows ~30.3% degradation (~6.7% per year) from 1 Apr 1979 through 31 Oct 1983.

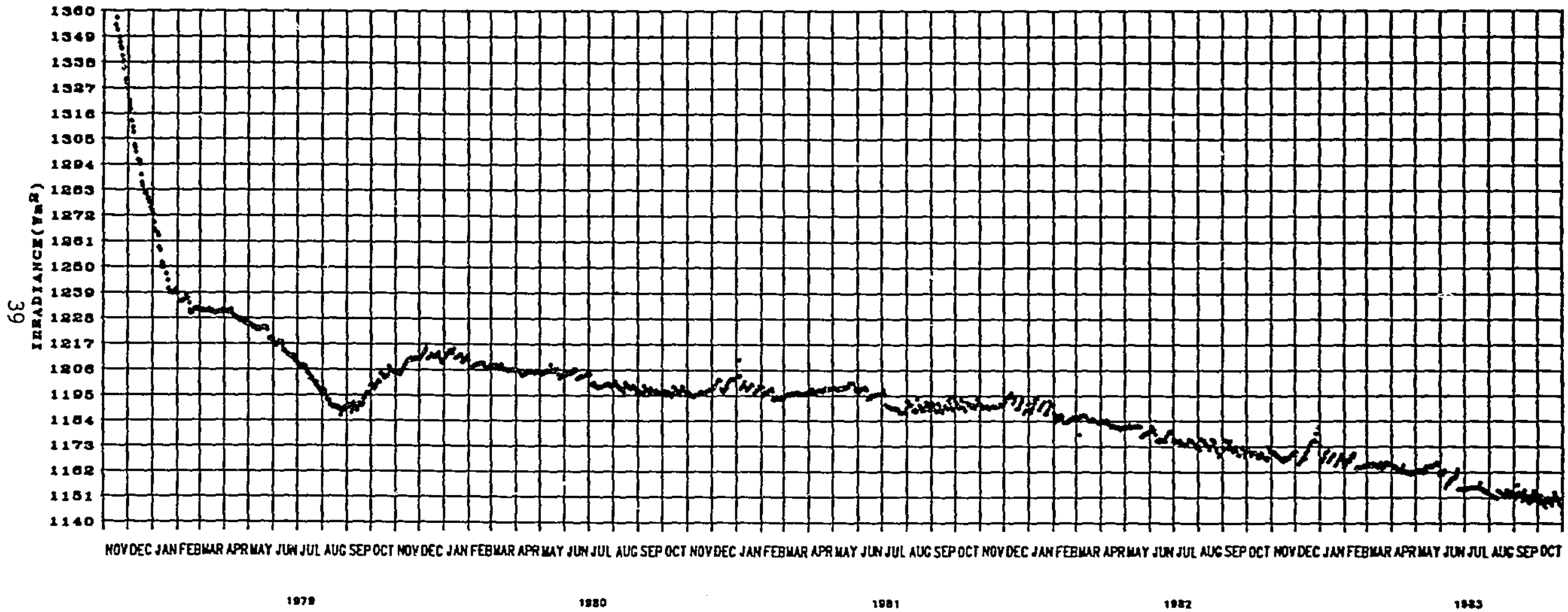
Channel 9: Initial rapid degradation and recovery from 16 Nov 1978 through 31 Mar 1979. Channel 9 shows an increase in irradiance of ~6.4% (~1.4% per year) from 1 Apr 1979 through 31 Oct 1983. There is a gap from mid-December 1982 through January 1983 where no data is available due to saturation of channel 9.

Channel 10c: Is a self calibrating cavity radiometer and the calibration data show no indication of degradation. It is therefore, hypothesized that the slight decrease in the solar constant from Nov. 1978 to Oct. 1983 may be real, however undetected degradation may exist. As discussed in Sec. 2.4 the short term excursions in the data correlate well with several solar activity indices.

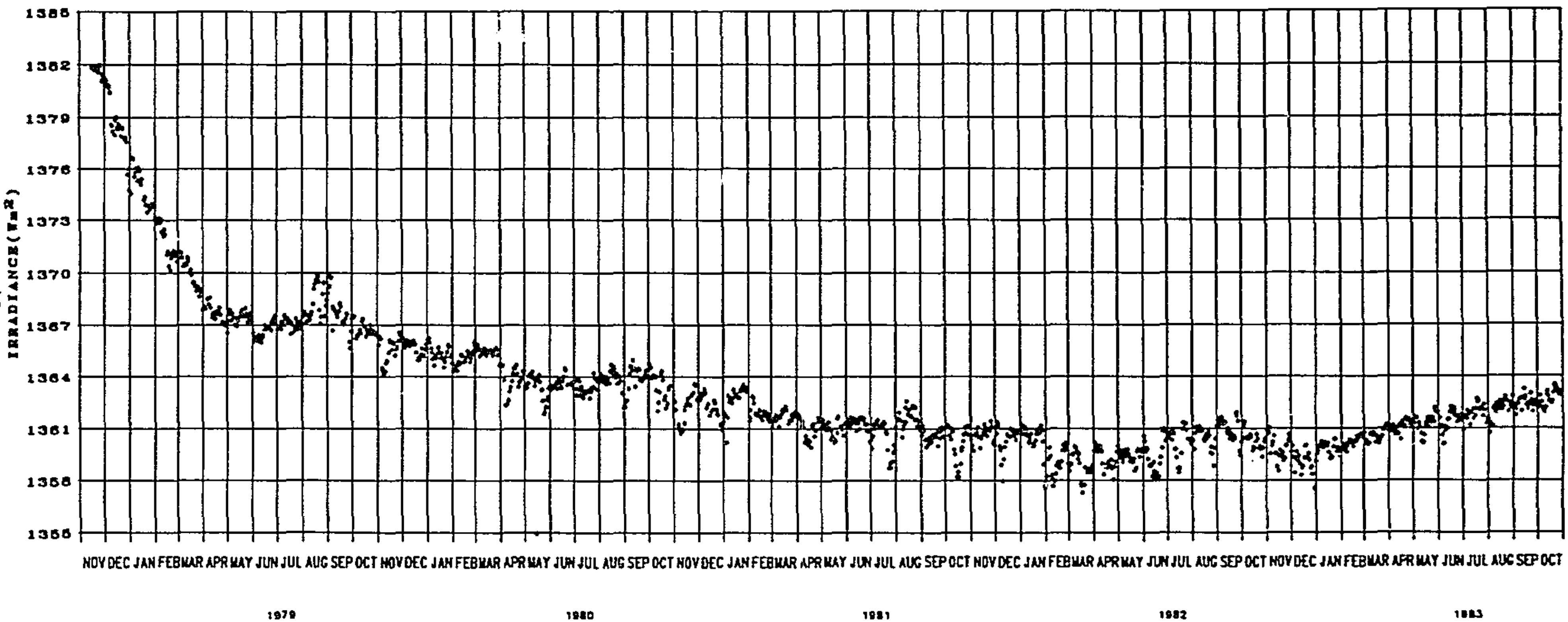
NIMBUS 7 CH. 2 IRRADIANCE



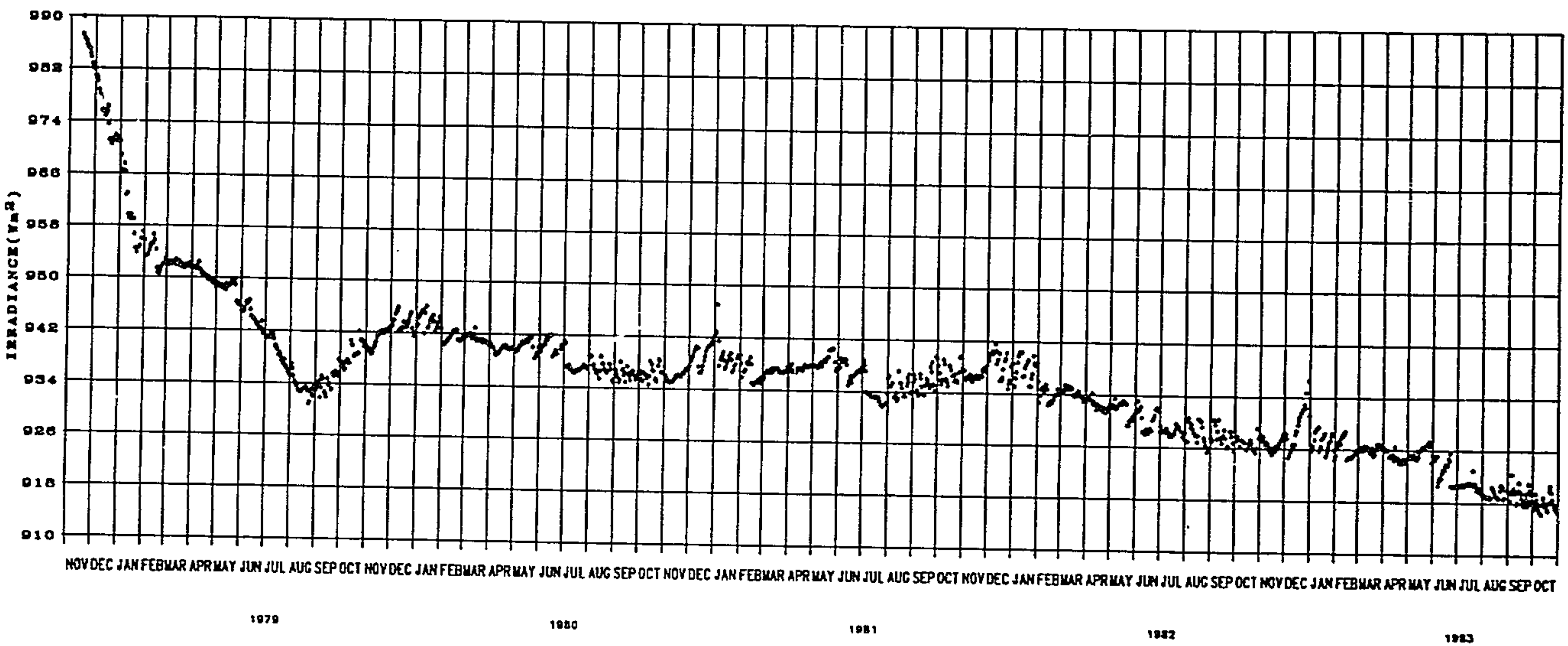
NIMBUS 7 CH. 2 IRRADIANCE

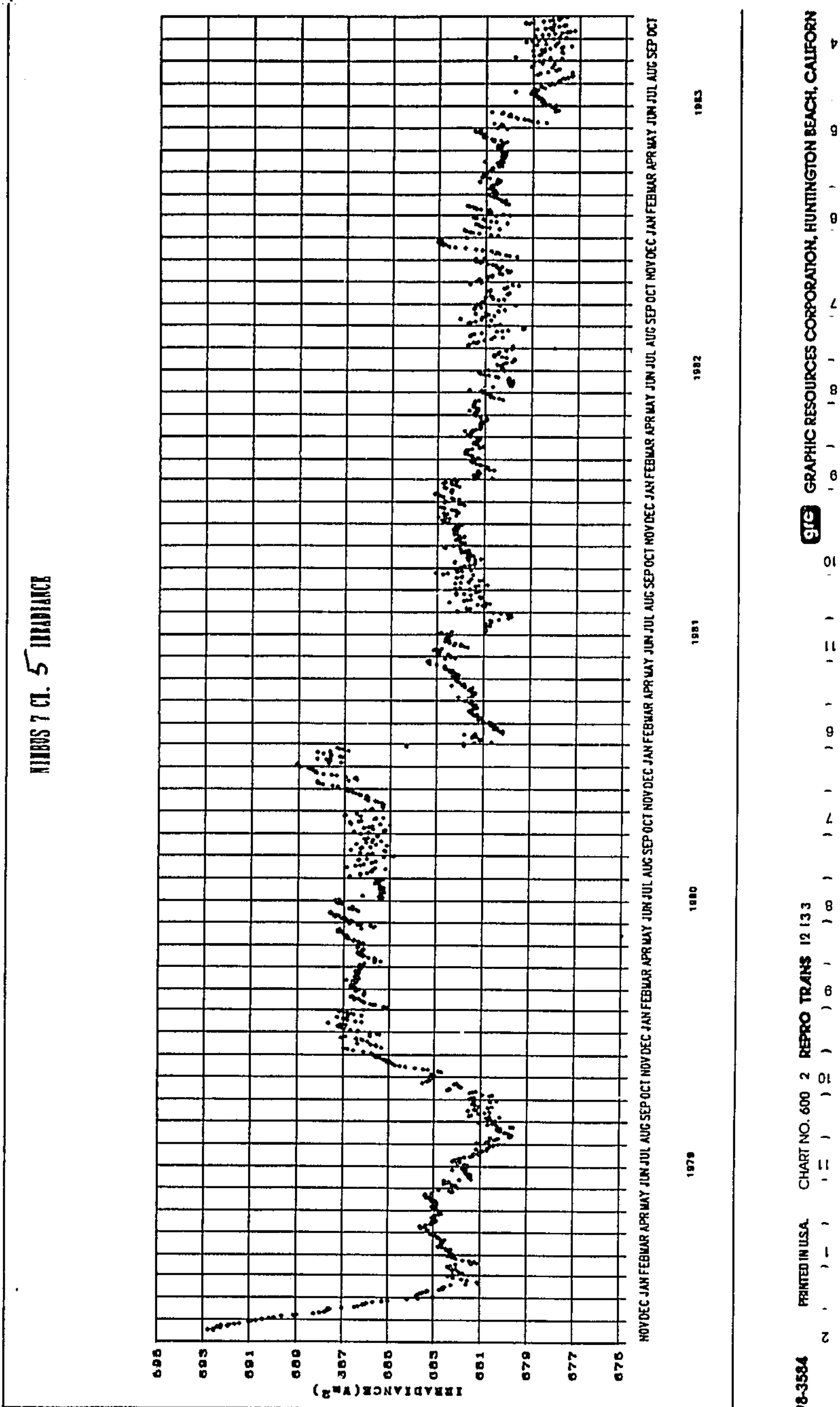


NIMBUS 7 CH. 3 IRRADIANCE



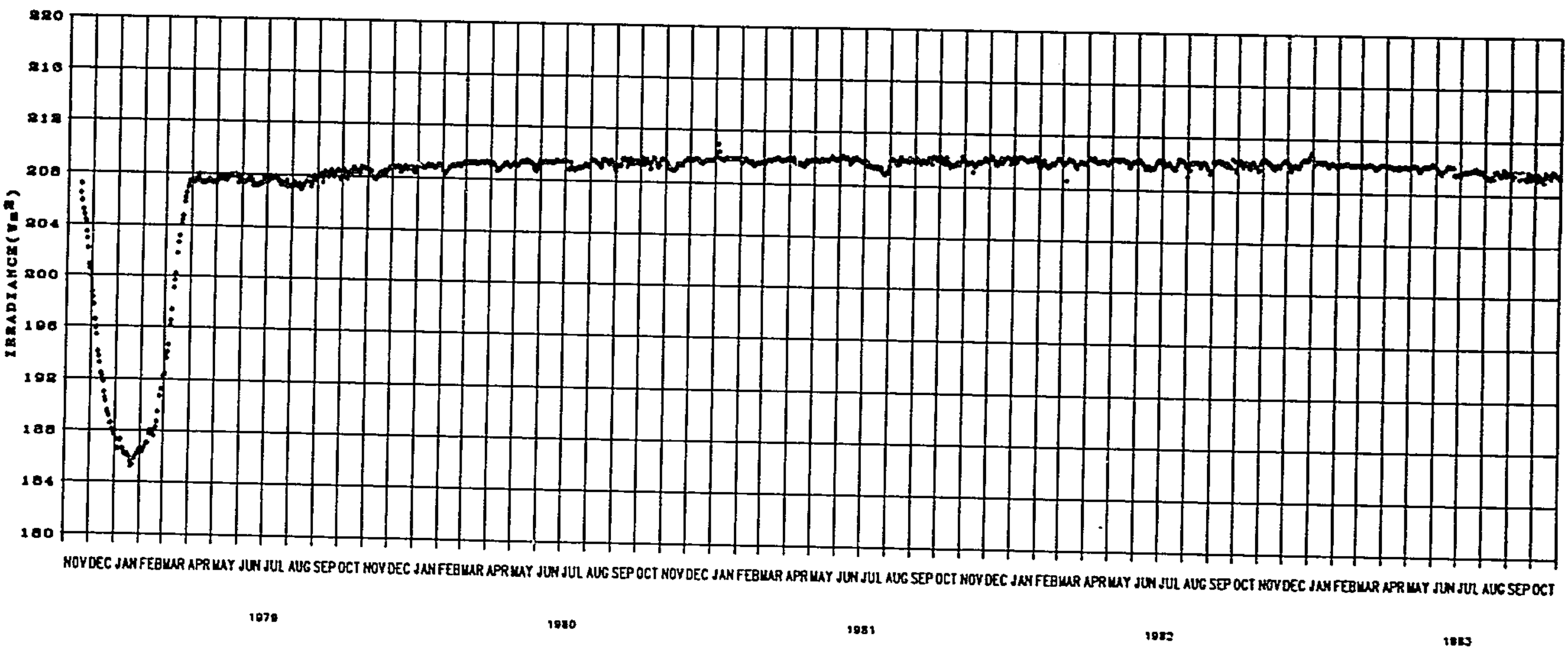
NIMBUS 7 CH. 4 IRRADIANCE



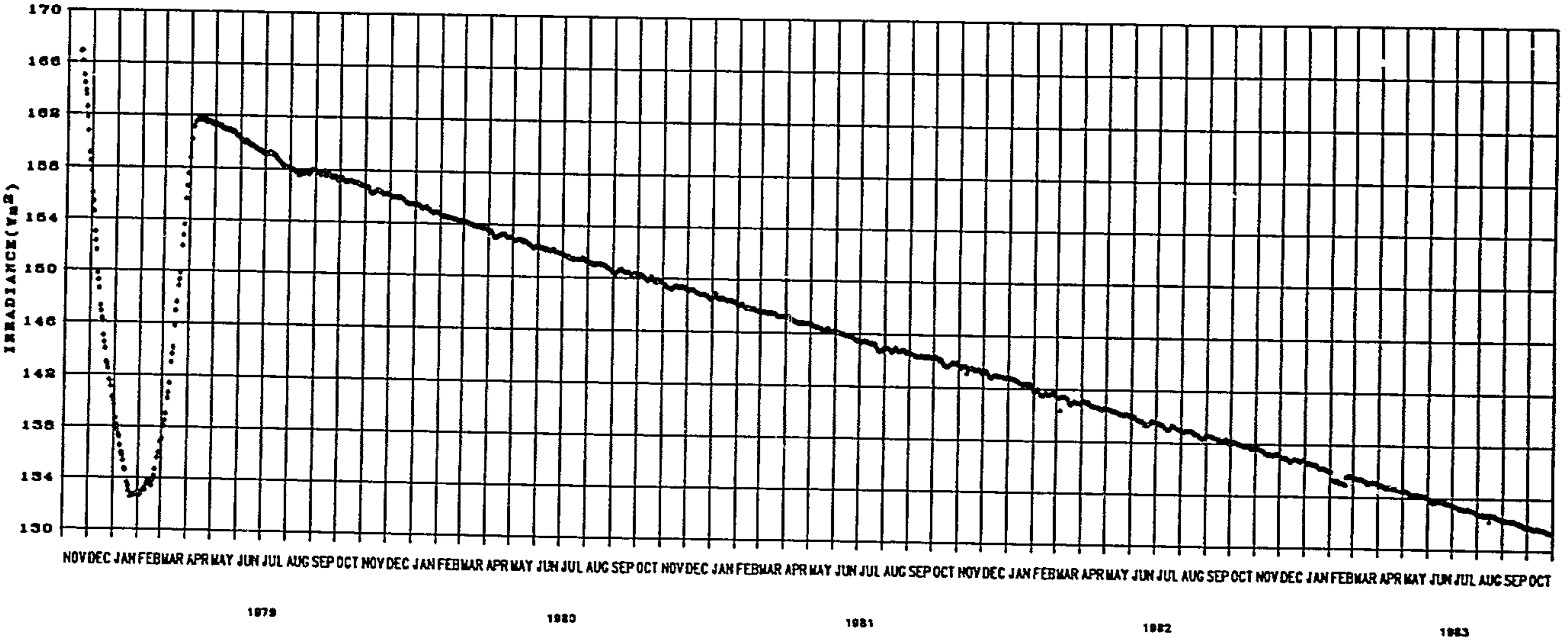


NIMBUS 7 CH. 5 IRRADIANCE

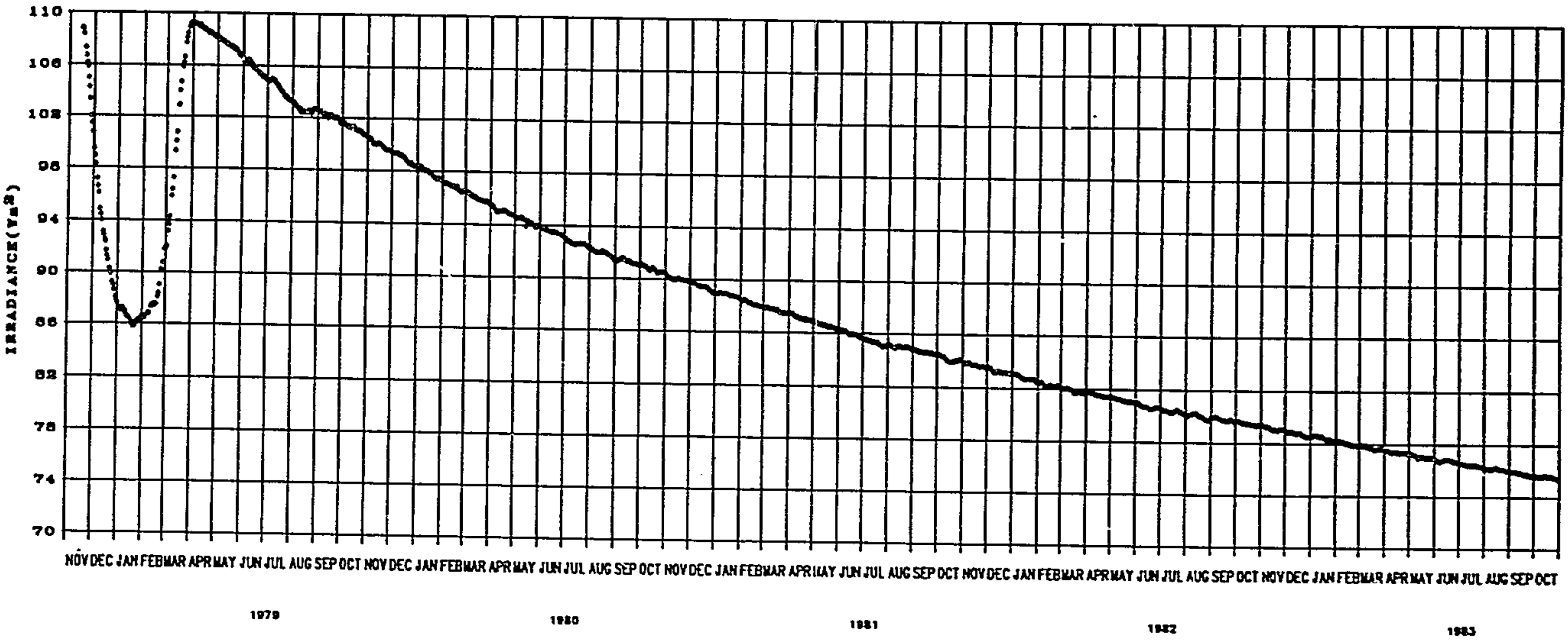
NIMBUS 7 CH. 6 IRRADIANCE



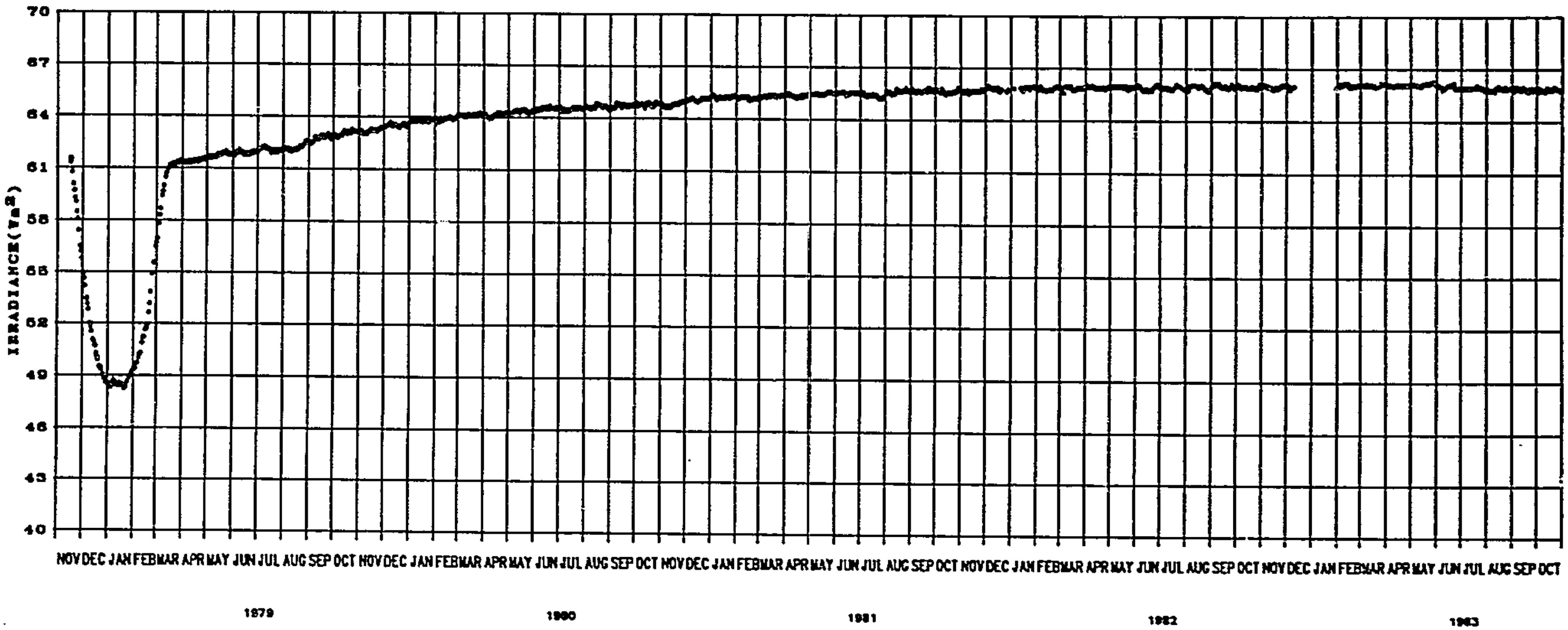
NIMBUS 7 CH. 7 IRRADIANCE



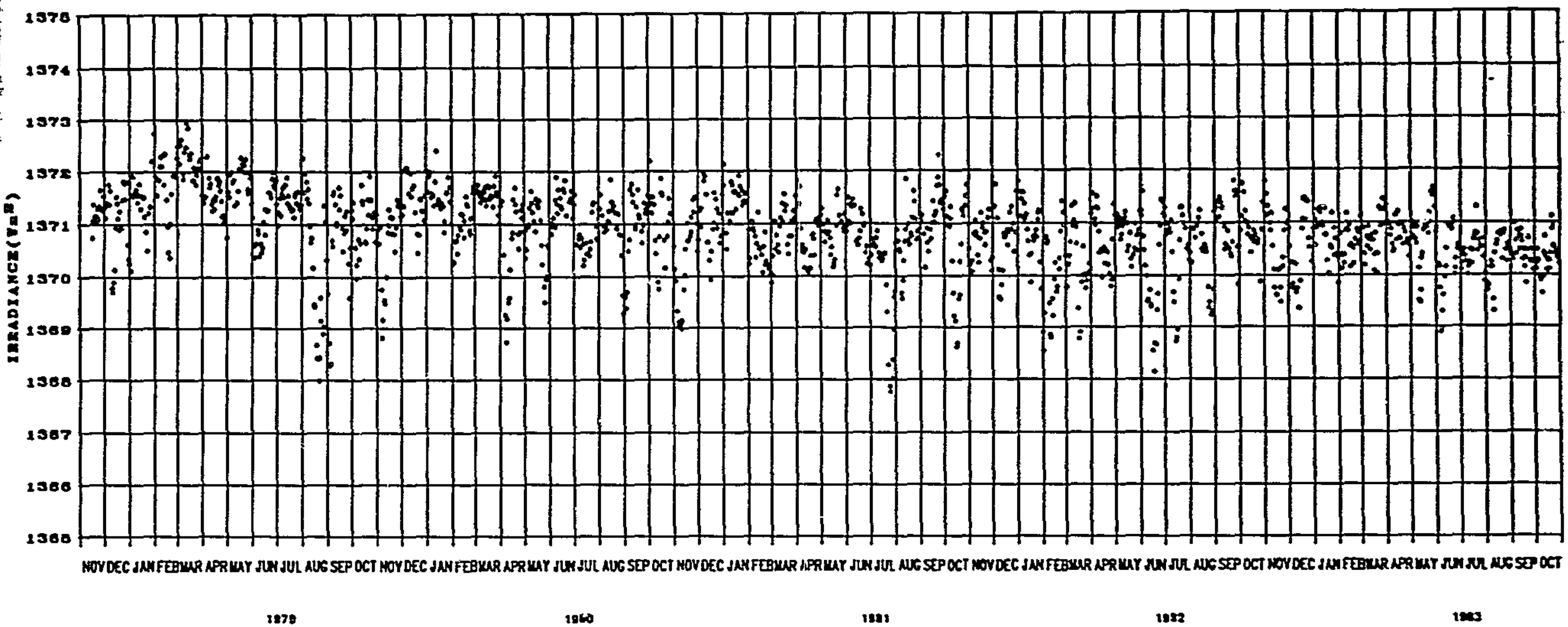
NIMBUS 7 CH. 8 IRRADIANCE



NIMBUS 7 CH. 9 IRRADIANCE



NIMBUS 7 CH. 10C IRRADIANCE



6.0 REFERENCES

Foukal, P.V., P.E. Mack, J.E. Vernassa, (1977), The Effect of Sunspots and Faculae on the Solar Constant, Ap. J., 215, 952-959.

Hickey, J.R., L.L. Stowe, H. Jacbowitz, P. Pelligrino, R.H. Maschhoff, F. House, and T.H. Vonder Haar, (1980), Initial Solar Irradiance Determination from Nimbus-7 Cavity Radiometer Measurements, Science, 208, 281-283.

Hickey, J.R., B.M. Alton. F.J. Griffin, H. Jacobowitz, P. Pelligrino and R.H. Maschhoff, (1981), "Indications of Solar Variability in the near UV from Nimbus 7 ERB Experiment", Collection of Extended Abstracts, IAMAP Third Scientific Assembly, Hamburg, F.R.G., Aug. 17-28, 1981, Boulder, CO.

Hickey, J.R., B.M. Alton, F.J. Griffin, H. Jacobowitz, P. Pellegrino, R.H. Maschhoff, E.A. Smith and T.H. Vonder Haar (1982), Extraterrestrial Solar Irradiance Variability, Two and One-half Years of Measurements from Nimbus-7, Solar Energy, 29, 125-127.

Hickey, J.R., and B.M. Alton, (1983), "Extraterrestrial Solar Irradiance-Results from the ERB Experiment of Nimbus-7", 5th Conference on Atmospheric Radiation, Baltimore, MD, October 31 - November 4, 1983, 444-447.

Jacobowitz, H., H.V. Soule, H.L. Kyle, F. House, and Nimbus-7 ERB Experiment Team, (1984), The Earth Radiation Budget (ERB) Experiment - An Overview, J. Geophys. Res., 89, Atmospheres, 4987-4996.

National Geophysical Data Center (NGDC), NOAA, Solar-Geophysical Data Part I (Prompt Reports), E/GC2, 325 Broadway, Boulder, CO.

Predmore, R.E., H. Jacobowitz, J.R. Hickey, (1982), "Exospheric Cleaning of the Earth Radiation Budget Solar Radiometer During Solar Maximum", Spacecraft Contamination Environment, Proc. SPIE, 338, 104-113.

Ray, S.N., R.J. Tighe and S.A. Scherrer, (1984), User's Guide for ERB 7 SEFDT, NASA Contract Report CR 170616, NASA/GSFC, Greenbelt, MD.

Smith, E.A., J.R. Hickey, R. Maschhoff, T.H. Vonder Haar, (1983a), "The Spectral Nature of Solar Irradiance Variability and its Phase Relationship to Solar Activity", 5th Conference on Atmospheric Radiation, Baltimore, MD, October 31 - November 4, 1983, 460-466.

Smith, E.A., T.H. Vonder Haar, J.R. Hickey, R. Maschhoff, (1983b), The Nature of the Short Period Fluctuations in Solar Irradiance Received by the Earth, Climatic Change, 5, 211-235.

Taylor, V.R., J.M. Vilardo, L.L. Stowe, and S.K. Vemury (1983a), Nimbus-7 ERB Emission Models for ERBE processing, 5th Conference on Atmospheric Radiation, AMS; Baltimore, MD; October 31 - November 4, 1983, 433-435.

Taylor, V.R., L.L. Stowe, and J.M. Vilardo, (1983b), Nimbus-7 ERB Reflectance Models for ERBE Processing, 5th Conference on Atmospheric Radiation, AMS; Baltimore, MD; October 31 - November 4, 1983, 452-455.

Taylor, V.R., and L.L. Stowe, (1984), Reflectance Characteristics of Uniform Earth and Cloud Surface Derived from Nimbus-7 ERB, J. Geophys. Res., 89, Atmospheres, 4987-4996.

Willson, R.C., S. Golkis, M. Janssen, J.S. Hudson, G.A. Chapman, (1981), Observations of Solar Irradiance Variability, Science, 211, 700-702.

APPENDIX A

NOPS STANDARD HEADER FILE AND TRAILER DOCUMENTATION FILE (TDF)

Every individual derivative products tape contains a standard Header File and a Trailer Documentation File.* Each is written in a format common to all archival tapes produced by the Nimbus Observation Processing System (NOPS).

The Standard Header File is the first file on any tape. It is used to define key characteristics of the tape.

The Trailer Documentation File (TDF) is the last file on any tape. It is intended to provide a geneology of the current product by providing data relating to previous products that went into the making of the current product.

C.1 Standard Header File

The standard header file contains two identical blocks (physical records) of 630 characters written in EBCDIC. Each block consists of five 126-Character lines.

Lines 1 and 2 are written according to a standardized format called the NOPS Standard Header Record.

Line 1:

COLUMNS	DESCRIPTION
1	An indicator to show that a TDF will be found at the end of a tape blank = No TDF * = TDF present
2-24	Label: NIMBUS-7$_b$NOPS$_b$SPEC$_b$No$_b$T
25-30	Tape Specification Number. See Appendix D
31-37	Label: $_b$SQ$_b$NO$_b$
38-39	PDF Code:

*Not included on ESAT tape.

b=blank

COLUMNS	DESCRIPTION AS=ESAT
40-45,47	Tape sequence number, defined as follows:
40	The last digit of the year in which the data were acquired.
41-43	Julian day of the year in which the data were acquired.
44	Sequence number for this particular product
45	The existing hyphen remains unless there is a remake of the tape for any reason. In this case, an ascending alpha character will replace the hyphen, and the most recent reasons for remake will be recorded in logical record 4 of the header.
47	This will remain as a blank unless it is needed to remove ambiguities in character 40. This may occur if data are being acquired on or after October 24, 1988.
46	Copy number 1 = original 2 = copy See Section C.3
47-52	Subsystem ID (with leading and trailing blank). For derivative products valid codes are SBUV or TOMS.
53-56	Generation (Source) Facility. For derivative products, valid codes are: NOAA (National Oceanographic and Atmospheric Administration); SACC (Science Applications Computing Center)
57-60	Label: $_b TO_b$
61-64	Destination Facility. For derivative products, this is IPD_b (Information Processing Division, Goddard)

COLUMNS	DESCRIPTION
65-87	Start year, julian day, hour, minute, second for data coverage on this tape, in the form ${}_{b}$START$_{b}$19YY$_{b}$DDD$_{b}$HHMMSS$_{b}$
88-106	End year, julian day, hour, minute, second for data coverage on this tape, in the form TO$_{b}$19YY$_{b}$DDD$_{b}$HHMMSS$_{b}$ In order to avoid unnecessary processing complications, the true ending date does not appear in the header record, Instead a fill date is used: 1999$_{b}$365$_{b}$240000
107-126	Generation year, julian day, hour, minute, second that the tape was created in the form: GEN$_{b}$19YY$_{b}$DDD$_{b}$HHMMSS$_{b}$

Line 2:

COLUMNS	DESCRIPTION
1-12	Software program name and version number.
13-18	Program documentation reference number, if it exists.
19	Blank
20-126	User defined comments that may be more relevant to the user than the preceding ones.

Lines 3-5 — May contain further descriptive information about the tape such as which software was used (program name, version number, and version date), or how this version of the data differs from the previous version.

NOPS PRODUCT SPECIFICATION CODES

Tapes: A six digit number prefixed with a T to denote TAPE will be used.

T	X_1	X_2	X_3	X_4	X_5	X_6

X_1 Subsystem
1 = ERB
2 = SMMR
3 = THIR
4 = SAM II
5 = LIMS
6 = SBUV/TOMS
7 = CZCS
8 = SAMS
9 = ILT

X_2 Source Facility (Same code as Destination Facility)

X_3 Destination Facility:
1 = NOC (Pre-NOPS)
2 = MDHS (NOPS)
3 = SACC
4 = IPD
5 = LARC
6 = NCAR
7 = NOAA
8 = OXFD
9 = USER

X_4,X_5: Tape number in sequence for subsystem (code to be derived depending on how many tapes are needed)

X_6 Tape Description:
1 = 9 Trk 1600 BPI
2 = 9 Trk 800 BPI
3 = 7 Trk 800 BPI
4 = 7 Trk 556 BPI
5 = HDT (IPD)
6 = 9 Trk 6250 BPI

STANDARD HEADER (PHYSICAL RECORD FORMAT)

MSB 24 22 20 18 16 14 12 10 8 6 4 2 1 LSB

Word	Bits 24–17	Bits 16–9	Bits 8–1	Bit count
1	$_b$Nimbus - 7$_b$NOPS$_b$SPEC$_b$NO$_b$T			
8	(24 Characters)			192
9	SPEC NO. (6 Digits)			
10	$_b$SQ$_b$NO$_b$ (7 Characters)			
13		PDFC CODE	(2 Char.)	
14	5 Digit Sequence No. (5 Characters)			
15			Hyphen (1 Char.)	408
16	1 Char. Type Copy No.	Blank Character		
17	(4 Characters) SUBSYSTEM I.D.			
18	Blank Character	SOURCE FACILITY		
19	(4 Characters)		Blank Character	
20	(T) Character	(Ø) Character	Blank Character	
21	(4 Characters)	DESTINATION FACILITY I.D.		
22		(23 Characters)		
	START YEAR, DAY, HOURS, MINUTES, SECONDS $_b$START$_b$19XX$_b$DDD$_b$HHMMSS$_b$			
29		(19 Characters)		696
	END DATE AND TIME OF DATA TO$_b$19XX$_b$DDD$_b$HHMMSS$_b$		*Some Facilities may not include end time in header	
36		(20 Characters)		
	DATE AND TIME TAPE WAS GENERATED GEN$_b$19XX$_b$DDD$_b$HHMMSS$_b$			
42				1008
	BLANK (126 Characters)			
84				2016
	BLANK (126 Characters)			
126				3024
	BLANK (126 Characters)			
168				4032
	BLANK (126 Characters)			
210				5040

EBCDIC TAPE FORMAT

APPENDIX B

SEQUENCE NUMBERS OF THE SEFDT TAPES USED TO GENERATE SOLAR DATA AT EPPLEY LABORATORIES FOR THE ERB SOLAR ANALYSIS TAPE (ESAT)

NOV 1978	AD83051-3
DEC 1978	AD83351-3
JAN 1979	AD90011-3
FEB 1979	AD90330-3
MAR 1979	AD90601-3
APR 1979	AD90911-3
MAY 1979	AD91211-3
JUN 1979	AD91521-3
JUL 1979	AD91821-3
AUG 1979	AD92131-3
SEP 1979	AD92441-3
OCT 1979	AD92741-3
NOV 1979	AD93051-3
DEC 1979	AD05771-3
JAN 1980	AD06241-3
FEB 1980	AD06661-3
MAR 1980	AD07111-3
APR 1980	AD07531-3
MAY 1980	AD07951-3
JUN 1980	AD08421-3
JUL 1980	AD08831-3
AUG 1980	AD09261-3
SEP 1980	AD09731-3
OCT 1980	AD10141-3
NOV 1980	AD03061-3
DEC 1980	AD03361-3
JAN 1981	AD10011-3
FEB 1981	AD19321-3
MAR 1981	AD10601-3
APR 1981	AD10921-3
MAY 1981	AD11211-3
JUN 1981	AD11521-3
JUL 1981	AD11821B3
AUG 1981	AD12131-3
SEP 1981	AD12441-3
OCT 1981	AD12741-3
NOV 1981	AD13051-3
DEC 1981	AD13361-3
JAN 1982	AD20011-3
FEB 1982	AD20321-3
MAR 1982	AD20601-3
APR 1982	AD20911-3
MAY 1982	AD21211-3
JUN 1982	AD21521-3
JUL 1982	AD21831-3
AUG 1982	AD22131-3
SEP 1982	AD22441-3
OCT 1982	AD22751-3
NOV 1982	AD23051-3
DEC 1982	AD23351-3
JAN 1983	AD30021-3
FEB 1983	AD30321-3
MAR 1983	AD30601-3
APR 1983	AD30911-3
MAY 1983	AD31221-3
JUN 1983	AD31521-3
JUL 1983	AD31821-3
AUG 1983	AD32141-3
SEP 1983	AD32441-3
OCT 1983	AD32741-3

APPENDIX C

TABLE OF SCALE FACTORS
DAILY MEAN DATA

DATA ITEM	MEAN	STANDARD DEVIATION	MINIMUM	MAXIMUM	NUMBER OF ORBITS
1. Orbit No	1,000	100,000	I	I	I
2. Year	I				
3. Day of Year	I				
4. Solar Azimuth	10,000	1,000,000	10	10	I
5. Solar Elevation	10,000	100,000	10	10	I
6. Gamma Angle	100,000	100,000	I	I	I
7. Ch. 3. Temp	10,000	100,000	10	10	I
8. Ch, 10c Temp	10,000	100,000	10	10	I
9. Ch. 1 Irrad.	10	100,000	10	10	I
10. Ch. 2 Irrad.	100	100,000	10	10	I
11. Ch. 3 Irrad.	100	1,000,000	10	10	I
12. Ch. 4 Irrad.	1000	100,000	10	10	I
13. Ch. 5 Irrad.	1000	100,000	10	10	I
14. Ch. 6 Irrad.	1000	100,000	100	100	I
15. Ch. 7 Irrad.	1000	1,000,000	100	100	I
16. Ch. 8 Irrad.	1000	1,000,000	100	100	I
17. Ch. 9 Irrad.	10,000	1,000,000	100	100	I
18. Ch. 10c Irrad.	100	1,000,000	100	10	I
19. Mission Day	I				
20. Off-axis Angle	10,000	100,000	10	10	I
21. Cosine Corrected Ch. 10c Irrad.	100	100,000	100	100	I

I = Integer value; not scaled

TABLE OF SCALE FACTORS
ORBITAL DATA

	DATA ITEM	SCALE FACTOR
1.	Orbit No.	I
2.	Year	I
3.	Day of Year	I
4.	Solar Azimuth	10
5.	Solar Elevation	10
6.	ISW	I
7.	Gamma Angle	I
8.	MSB E-S Dist.	I
9.	LSB E-S Dist.	I
10.	Ch. 3 Temp	10
11.	Ch. 10c Temp	10
12.	Ch. 1 Irrad.	10
13.	Ch. 2 Irrad.	10
14.	Ch. 3 Irrad	10
15.	Ch. 4 Irrad.	10
16.	Ch. 5 Irrad.	10
17.	Ch. 6 Irrad.	100
18.	Ch. 7 Irrad.	100
19.	Ch. 8 Irrad.	100
20.	Ch. 9 Irrad.	100
21.	Ch. 10c Irrad.	10
22.	So. Term (hrs/min)	I
23.	So. Term (secs)	I
24.	Mission Day	I
25.	Off-axis angle	I
26.	Cosine-Corrected Ch. 10c Irrad.	10

I = Integer Value, not scaled

TABLE OF SCALE FACTORS
SOLAR ACTIVITY DATA

	DATA ITEM	SCALE FACTOR
1.	YEAR	I
2.	DAY OF YEAR	I
3.	NO. OF PLAGE OBSERVATIONS	I
4.	SUNSPOT NO.	I
5.	SOLAR FLUX (2800 MHz)	10
6.	DAILY CALCIUM PLAGE INDEX	10
7.	GEOMAGNETIC INDEX	I
8.	MCMATH-HALE REG. NO.	I
9.	CENTRAL MERIDIAN PASSAGE DATE	10
10.	LATITUDE	I
11.	CENTRAL MERIDIAN DISTANCE	I
12.	CARRINGTON LONGITUDE	I
13.	AREA	I
14.	INTENSITY	10

I = Integer Value, not scaled

APPENDIX D

DATA AVAILABILITY

To obtain archived data or information about it call or write:

National Space Sciences Data Center
Request Coordinator, Code 633
NASA, Goddard Space Flight Center
Greenbelt, Maryland 20771
Phone: (301)-344-6695

A User's Guide should be ordered by all first time users of the data. Researchers who reside outside the USA should direct their requests to:

World Data Center A for Rockets and Satellites
Code 630.2
Goddard Space Flight Center
Greenbelt, Maryland 20771 USA
(301) 344-6695

The data will also be made available on the NASA/GSFC Pilot Climate Data System (PCDS). This is a scientific information system for selected climate data sets. Users of the system may access the data and information about the data via local (i.e. at GSFC) and remote computer terminals. They may learn about climate data, its availability, the details of the PCDS holdings, access, select and subset data sets of interest, perform data manipulation and comparisons and obtain a wide variety of graphical representations of data.

The PCDS has many climate data sets most of spacecraft origin.

Data sets from the following experiments are supported in the PCDS.

- o Nimbus-4 Backscatter Ultraviolet (BUV)
- o Nimbus-4/5 Selective Chopper Radiometer (SCR)
- o Nimbus-5 Electrically Scanning Microwave Radiometer (ESMR)
- o Nimbus-7 Limb Infrared Monitor of the Stratosphere (LIMS)
- o Nimbus-7 Solar Backscatter Ultraviolet (SBUV)
- o Nimbus-7 Total Ozone Mapping Spectrometer (TOMS)

- Nimbus-7 Earth Radiation Budget (ERB)
- Nimbus-7 Stratospheric Aerosol Measurement (SAM II)
- AEM-2 Stratospheric Aerosol and Gas Experiment (SAGE)
- National Meteorological Center (NMC) Daily Analyses of Atmospheric Parameters
- World Monthly Surface Station Climatology
- First Global Atmospheric Research Program Global Experiment (FGGE)
- NOAA Heat Budget Data
- Middle Atmosphere Electrodynamics (MAD) miscellaneous rocket data sets

In addition to the ERB Solar Analysis data set, the PCDS will also make available in the future selected data sets produced for the International Satellite Cloud Climatology Project (ISCCP).

Those interested in utilizing the PCDS should contact:

Lloyd A. Treinish or Paul H. Smith
National Space Science Data Center
Code 634
NASA, Goddard Space Flight Center
Greenbelt, Maryland 20770

Phone: (301)-344-9489
or (301)-344-5876

APPENDIX E

COMPUTER PROGRAM AND SAMPLE OUTPUT

```
**** TSO FOREGROUND HARDCOPY ****
DSNAME=X7ORM.SOLAR.ESAT.ANALYSIS.FORT                    (ESATREAD)

C
C***********************************************************************
C       FUNCTION - THIS PROGRAM READS THE ERB SOLAR ANALYSIS TAPE (ESAT)
C       AND DUMPS THE NOPS STANDARD HEADER FILE, THE FIRST 10
C       RECORDS OF THE DAILY MEAN FILE, THE FIRST 10 RECORDS
C       OF THE ORBITAL FILE, AND THE FIRST 10 RECORDS OF THE
C       SOLAR ACTIVITY FILE.
C        THIS PROGRAM CAN BE MODIFIED TO DUMP AS MANY OR AS FEW
C        RECORDS DESIRED FROM ANY FILE BY SPECIFYING THE
C        FILE NUMBER TO BE READ AND RECORD NUMBERS TO DUMP.
C
C       ARGUMENT LIST - NONE.
C       -------- ----
C
C       LOCAL VARIABLES:
C       ----- ----------
C     VARIABLE      TYPE    DESCRIPTION
C       --------    ----      -----------
C       IFILE         I*4      FILE NUMBER TO BE READ:
C                              IFILE(1)=1 - NOPS STANDARD LABEL
C                              IFILE(2)=2 - ORBITAL SOLAR DATA
C                              IFILE(3)=3 - DAILY MEAN SOLAR DATA
C                              IFILE(4)=4 - SOLAR ACTIVITY INDICATORS
C       IREC1         I*4      FIRST RECORD NUMBER
C       IREC2         I*4      LAST RECORD NUMBER
C
C      CALLED FROM: NONE. THIS IS THE MAIN PROGRAM
C
C      CALLS TO:
C             NOPS    -  READS THE NOPS STANDARD HEADER FILE
C             DMEAN   -  READS THE DAILY MEAN SOLAR DATA FILE
C             ORBTAL  -  READS THE ORBITAL SOLAR DATA FILE
C             SOLAR   -  READS THE SOLAR ACTIVITY DATA FILE
C
C       INPUT TAPE: 9-TRACK,1600 BPI, RECFM=U, BLKSIZE=32760
C
C       PROGRAMMER: G. MAJOR, RESEARCH & DATA SYSTEMS, INC.
C
C       LANGUAGE/COMPUTER: VS FORTRAN/IBM 3081 AT NASA/GSFC
C
C       VERSION DATE: JULY 1984
C
C***********************************************************************
C
        DIMENSION IFILE(4)
C
       IFILE(1)=1
        IFILE(2)=2
       IFILE(3)=3
       IFILE(4)=4
       IREC1=1
       IREC2=10
C
       DO 10 I=1,4
         IF(IFILE(I).EQ.1) THEN
           IF=1
```

```
C
C       VERSION DATE: JULY 1984
C
C***********************************************************************
C
C
      REAL*4 BARRAY(68),DD
      INTEGER*2 R1(2),JA,JB
      INTEGER*4 RARRAY(94),LENGTH,TMPARY(68)
      EQUIVALENCE (R1(1),RARRAY(1))
      LENGTH=376
      IN=0
C
       WRITE(6,1000) IFILE
 1000  FORMAT(//' OPEN FILE',I3,' TO READ DATA'//10X,' DAILY MEAN ERB',
     1  ' SOLAR DATA'//)
C
C       POSITION TAPE TO FILE 3
C
       CALL POSN(1,10,IFILE)
C
      DO 105 K=1,1811
        CALL FREAD(RARRAY,10,LENGTH,900,902)
          JA=R1(1)
          JB=R1(2)
C       IF(K.EQ.1.OR.K.LE.50) THEN
C
C  SEPERATION OF INTEGERS TO BE LATER CONVERTED TO REAL FROM THOSE
C  REMAINING INTEGERS. THE INTEGERS THAT WILL BE MADE REAL ARE
C  STORED IN TMPARY(70).
C
          IL=5
          IK=0
          LL=13
C
          DO 600 L=2,94
            IF((L.GE.4).AND.(L.LE.8)) GO TO 600
              IF(LL.GT.83)GO TO 590
              IF(L.EQ.LL)GO TO 589
 590           CONTINUE
                IF((L.EQ.21).OR.(L.EQ.22)) GO TO 600
                  IF((L.EQ.84).OR.((L.EQ.89).OR.(L.EQ.94)))GO TO 600
                    IK=IK+1
                    TMPARY(IK)=RARRAY(L)
                    GO TO 600
 589           LL=LL+IL
 600      CONTINUE
C
C  CONVERSION OF INTEGER(REALS) TO REAL*4
C
          MML=14
          ML=15
          MLL=16
          MMML=33
C
          DO 601 M=1,68
            DD=REAL(TMPARY(M))
            IF(DD.EQ.-9999.) BARRAY(M)=DD
C
            IF(M.EQ.MML)THEN
```

```
            IF(DD.EQ.-9999.)GO TO 32
            IF(MML.EQ.30) GO TO 21
            IF((MML.GE.46).AND.(MML.LE.58)) GO TO 21
              BARRAY(M)=DD/100000.
              MML=MML+4
              GO TO 201
 21           BARRAY(M)=DD/1000000.
 32           MML=MML+4
 201          CONTINUE
          ENDIF
C
          IF(M.EQ.ML) THEN
            IF(DD.EQ.-9999.)GO TO 33
            IF((ML.GE.43).AND.(ML.LE.55)) GO TO 22
            IF(ML.EQ.67) GO TO 22
              BARRAY(M)=DD/10.
              ML=ML+4
              GO TO 202
 22           BARRAY(M)=DD/100.
 33           ML=ML+4
 202          CONTINUE
          ENDIF
C
          IF(M.EQ.MLL) THEN
            IF(DD.EQ.-9999.)GO TO 34
            IF((ML.GE.44).AND.(ML.LE.56)) GO TO 23
            IF(ML.EQ.68) GO TO 23
              BARRAY(M)=DD/10.
              MLL=MLL+4
              GO TO 203
 23           BARRAY(M)=DD/100.
 34           MLL=MLL+4
 203          CONTINUE
          ENDIF
C
          IF(M.EQ.MMML) THEN
            IF(TMPARY(M).EQ.-9999.)GO TO 35
            IF(MMML.GT.49) GO TO 204
              BARRAY(M)=DD/1000.
 35           MMML=MMML+4
 204          CONTINUE
          ENDIF
C
          IF(DD.EQ.-9999.) GO TO 599
C
          IF((M.EQ.5).OR.(M.EQ.6)) BARRAY(M)=DD/10.
          IF((M.EQ.9).OR.(M.EQ.10)) BARRAY(M)=DD/10.
          IF(M.EQ.21) BARRAY(M)=DD/10.
C
          IF((M.EQ.25).OR.(M.EQ.29)) BARRAY(M)=DD/100.
          IF((M.EQ.57).OR.(M.EQ.65))  BARRAY(M)=DD/100.
C
          IF(M.EQ.1) BARRAY(M)=DD/1000.
C
          IF((M.EQ.3).OR.(M.EQ.7)) BARRAY(M)=DD/10000.
          IF((M.EQ.13).OR.(M.EQ.17)) BARRAY(M)=DD/10000.
          IF((M.EQ.53).OR.(M.EQ.61)) BARRAY(M)=DD/10000.
C
          IF((M.EQ.2).OR.(M.EQ.8)) BARRAY(M)=DD/100000.
          IF((M.EQ.11).OR.(M.EQ.12)) BARRAY(M)=DD/100000.
```

```
     1 4X,I8)
            WRITE(6,509) (BARRAY(J),J=33,36),RARRAY(53),
     1                   (BARRAY(J),J=37,40),RARRAY(58)
 509    FORMAT(1X,'CH. 4 IRR. NOT SCALED',14X,F12.3,1X,
     1  F12.5,2(1X,F12.1),4X,I8/1X,'CH. 5 IRR. NOT SCALED',
     2  14X,F12.3,1X,F12.5,2(1X,F12.1),4X,I8)
            WRITE(6,510) (BARRAY(J),J=41,44),RARRAY(63)
 510   FORMAT(1X,'CH. 6 IRR. NOT SCALED',14X,F12.3,1X,F12.5,2(1X,F12.2),
     1 4X,I8)
            WRITE(6,511) (BARRAY(J),J=45,48),RARRAY(68),
     1                    (BARRAY(J),J=49,52),RARRAY(73)
 511   FORMAT(1X,'CH. 7 IRR. NOT SCALED',14X,F12.3,1X,F12.6,2(1X,F12.2),
     1 4X,I8/1X,'CH. 8 IRR. NOT SCALED',14X,F12.3,1X,F12.6,2(1X,F12.2),
     2 4X,I8)
            WRITE(6,512) (BARRAY(J),J=53,56),RARRAY(78)
 512   FORMAT(1X,'CH. 9 IRR. NOT SCALED',14X,F12.4,1X,F12.6,2(1X,F12.2),
     1 4X,I8)
            WRITE(6,513) (BARRAY(J),J=57,60),RARRAY(83),RARRAY(84)
 513   FORMAT(1X,'CH.10C IRR. NOT SCALED',13X,F12.2,1X,F12.6,
     1 2(1X,F12.1),4X,I8/1X,'MISSION DAY',28X,I8)
            WRITE(6,514)  (BARRAY(J),J=61,64),RARRAY(89)
 514   FORMAT(1X,'OFF AXIS ANGLE IN DEG.',13X,F12.4,1X,F12.5,2(1X,F12.1),
     1 4X,I8)
            WRITE(6,515) (BARRAY(J),J=65,68),RARRAY(94)
 515   FORMAT(1X,'COS. CORRECTED SEFDT SOLAR IRR. CH.10C',F9.2,1X,F12.5,
     1 2(1X,F12.2),4X,I8)
 899      CONTINUE
           ENDIF
C
 900    CONTINUE
 902    CONTINUE
C
 105    CONTINUE
        WRITE(6,2000)
 2000   FORMAT(//' END OF FILE 2 PROCESSING'//)
        RETURN
        END
C
        SUBROUTINE ORBTAL(IF,IREC1,IREC2)
C
C*************************************************************
C
C   FUNCTION - THIS ROUTINE WILL OUTPUT ERB ORBITAL SOLAR DATA FROM
C              TAPE WITH A CONSISTENT FORMAT FOR ALL DATA RECORDS
C
C         ARGUMENT LIST:
C         -------- -----
C         VARIABLE  TYPE  IO DESCRIPTION
C         --------  ----  -- -----------
C         IF        I*4   I  FILE POSITION
C         IREC1     I*4   I  FIRST RECORD NUMBER
C         IREC2     I*4   I  LAST RECORD NUMBER
C
C         LOCAL VARIABLES USED:
C         ----- --------- -----
C         VARIABLE  TYPE  DESCRIPTION
C         --------  ----  -----------
C         JARRAY    I*2   ARRAY OF DATA FOR ONE SOLAR ORBITAL RECORD
C         R10C      I*4   COSINE-CORRECTED CHANNEL 10C SOLAR DATA
C         LENGTH    I*4   LENGTH OF ONE SOLAR ORBITAL RECORD IN BYTES
```

```
C
C       CALLED FROM: MAIN
C
C       CALLS TO:
C               POSN  -  FTIO TAPE POSITIONING ROUTINE
C               FREAD -  FTIO TAPE READ ROUTINE
C
C       PROGRAMMER: M. WEISS, RESEARCH & DATA SYSTEMS, INC.
C
C       LANGUAGE/COMPUTER: VS FORTRAN/IBM 3081 AT NASA/GSFC
C
C       VERSION DATE: JULY 1984
C
C***********************************************************************
C
      INTEGER*2 RARRAY(42),JARRAY(42)
      INTEGER*4 R1(12)
       REAL*4 R2(12),R10C
      EQUIVALENCE (R1(1),RARRAY(13))
      EQUIVALENCE (R10C,RARRAY(41))
      LENGTH=84
      IN=0
C
C
       WRITE(6,1000)
 1000  FORMAT(//' OPEN FILE 2 FOR PROCESSING'//10X,'ORBITAL ERB',
     1 ' SOLAR DATA'//)
C
C       POSITION TAPE TO FILE 2 FOR PROCESSING
C
       CALL POSN(1,10,IF)
C
      DO 105 K=1,16778
        CALL FREAD(JARRAY,10,LENGTH,900,902)
          DO 10 I=1,42
            RARRAY(I)=JARRAY(I)
 10       CONTINUE
C
          K1=0
          DO 20 I=13,35,2
            K1=K1+1
            R1(K1)=RARRAY(I)
 20       CONTINUE
          R10C=RARRAY(41)/10.
C
C  HEADINGS FOR OUTPUT OF ORBITAL DATA
C
C         IF(K.EQ.2.OR.K.EQ.6000) THEN
         IF(K.GE.IREC1.AND.K.LE.IREC2) THEN
            IN=IN+1
          IF(IN.GT.1) GO TO 390
            WRITE(6,490)
 490   FORMAT(5X,'FIVE YEARS OF ESAT ORBITAL DATA FROM NIMBUS 7')
            WRITE(6,493)
 493   FORMAT(10X,'ESD  = EARTH SUN DISTANCE',1X/)
C
C  FORMATTED OUTPUT OF ALL VARIABLES FOR AN
C  OBSERVATION OF ORBITAL DATA
C
 390        WRITE(6,494) RARRAY(1),RARRAY(2)
```

```
 494  FORMAT(////5X,'RECORD NUMBER=',I5,2X,'RECORD IDENTIFICATION=',I3)
            WRITE(6,495)
 495  FORMAT(8X,'ORBIT',9X,'YEAR',8X,'DAY OF',7X,'SOLAR',8X,
     1 'SOLAR',8X,'INSTR',8X,'GAMMA',9X,'MSB OF')
            WRITE(6,496)
 496  FORMAT(7X,'NUMBER',22X,'YEAR',7X,'AZIMUTH',5X,'ELEVATION',4X,
     1 'STAT WORD',6X,'ANGLE',10X,'ESD')
         SOLA=RARRAY(7)/10.
         SOLE=RARRAY(8)/10.
            WRITE(6,497) RARRAY(3),(RARRAY(J),J=5,6),SOLA,SOLE,
     1      (RARRAY(J1),J1=9,11)
 497  FORMAT(4X,I8,2(5X,I8),2(5X,F8.1),3(5X,I8),1X/)
            WRITE(6,498)
 498  FORMAT(7X,'LSB OF',4X,'CH 3 DEG C',2X,'CH 10C DEG C',3X,
     1 'CH 1 IRR',5X,'CH 2 IRR',5X,'CH 3 IRR',5X,'CH 4 IRR',5X,
     2 'CH 5 IRR',5X,'CH 6 IRR')
            WRITE(6,499)
 499  FORMAT(9X,'ESD',5X,'--- -------',2X,'--- -------',2X,
     1 '--- -------',2X,'--- -------',2X,'--- -------',2X,'--- -------',
     2 2X,'--- -------',2X,'--- -------')
            DO 50 J3=1,7
              R2(J3)=R1(J3)/10.
  50        CONTINUE
            R2(8)=R1(8)/100.
            WRITE(6,510)  RARRAY(12),(R2(J),J=1,8)
 510  FORMAT(4X,I8,7(5X,F8.1),5X,F8.2,1X/)
            WRITE(6,501)
 501  FORMAT(5X,'CH 7 IRR',5X,'CH 8 IRR',5X,'CH 9 IRR',4X,
     1 'CH 10C IRR',5X,'SOUTHTERM',4X,'SOUTHTERM',5X,'MISSION',
     2 5X,'OFF AXIS',3X,'COS CORR')
            WRITE(6,502)
 502  FORMAT(4X,'--- --------',1X,'--- --------',1X,'--- --------',1X,
     1 '--- -------',3X,'TIME(HR/MIN)',2X,'TIME(SEC)',7X,'DAY',
     2 6X,'ANGLE(DEG)',1X,'SEFDT CH10C')
            DO 60 J4=9,12
              R2(J4)=R1(J4)/100.
  60        CONTINUE
            WRITE(6,511) (R2(J),J=9,12),(RARRAY(M),M=37,40),R10C
 511    FORMAT(4X,4(F8.2,5X),4(I8,5X),F8.1,1X///)
         ENDIF
C          IF(K.EQ.6295.OR.K.EQ.12295) THEN
C
C          IF(K.EQ.13147.OR.K.EQ.16147) THEN
C          ENDIF
C
 900    CONTINUE
 902    CONTINUE
C
 105    CONTINUE
        WRITE(6,2000)
 2000   FORMAT(//' END OF FILE 3 PROCESSING'//)
        RETURN
        END
C
        SUBROUTINE SOLAR(IF,IREC1,IREC2)
C*****************************************************************
C         FUNCTION - THIS PROGRAM READS THE SOLAR ACTIVITY INDICATORS FILE
C                    OF THE ERB SOLAR ANLAYSIS TAPE (ESAT).
C                    SELECTED RECORDS ARE PRINTED OUT.
C
```

```
C       ARGUMENT LIST:
C       -------- -----
C       VARIABLE  TYPE  IO  DESCRIPTION
C       --------  ----  --  -----------
C       IF        I*4   I   FILE POSITION
C       IREC1     I*4   I   FIRST RECORD
C       IREC2     I*4   I   LAST RECORD
C
C       LOCAL VARIABLES USED:
C       ----- --------- -----
C       VARIABLE  TYPE  DESCRIPTION
C       --------  ----  -----------
C       SOL       I*4   ARRAY OF SOLAR ACTIVITY PARAMETERS
C       IOPLAG    I*4   ARRAY OF SOLAR PLAGE DATA
C       SOLACT    I*2   ARRAY CONTAINS SOLAR ACTIVITY DATA FOR 1 RECORD
C       IREC      I*2   RECORD NUMBER
C       IRECID    I*2   RECORD ID
C       YEAR      I*2   YEAR OF OBSERVATION
C       DAY       I*2   DAY OF OBSERVATION
C       NOBS      I*4   NUMBER OF PLAGE REGION OBSERVATIONS PER DAY
C       ISS       I*4   ZURICH SUNSPOT NUMBER
C       MHZ       I*4   2800 MHZ SOLAR FLUX
C       CAL       I*4   DAILY CALCIUM PLAGE INDEX
C       IGEO      I*4   GEOMAGNETIC INDEX (AP SERIES)
C       PLAGE     R*4   PLAGE REGION DATA. CONTAINS:
C                       CMPD - CENTRAL MERIDIAN PASSAGE DATE
C                       MHRN - MCMATH-HALE REGION NUMBER
C                       LAT  - LATITUDE OF REGION
C                       CMD  - CENTRAL MERIDIAN DISTANCE OF REGION
C                       LON  - CARRINGTON LONGITUDE OF REGION
C                       AREA - AREA OF REGION IN MILLIONTHS OF SOL. HEM.
C                       INT  - INTENSITY OF REGION (1=FAINT,5=BRIGHT)
C
C
C       NOTE: THERE MAY BE MORE THAN ONE PLAGE REGION OBSERVATION
C             PER DAY. THEREFORE PLAGE REGION RECORDS ARE READ
C             SEPERATELY DEPENDING ON THE VALUE OF NOBS.
C
C       CALLED FROM: MAIN
C
C       CALLS TO:
C               POSN  -  FTIO TAPE POSITIONING ROUTINE
C               FREAD -  FTIO TAPE READ ROUTINE
C
C       PROGRAMMER: G. MAJOR, RESEARCH & DATA SYSTEMS, INC.
C
C       LANGUAGE/COMPUTER: VS FORTRAN/IBM 3081 AT NASA/GSFC
C
C       VERSION DATE: JULY 1984
C
C***********************************************************************
C
        INTEGER*4 SOL(7),IOPLAG(350)
        INTEGER*2 SOLACT(714),IREC,IRECID,YEAR,DAY
        REAL*4 MHZ,PLAGE(50,7)
C
         EQUIVALENCE(SOLACT(5),SOL(1))
         EQUIVALENCE(SOLACT(15),IOPLAG(1))
C
        WRITE(6,3000)
```

```
         J3=J3+1
C        WRITE(6,9008) IOPLAG(K)
C9008    FORMAT(' IOPLAG=',I10)
 111    CONTINUE
      END IF
C
C     UNPACK PLAGE REGION DATA
C
      K=0
      DO 112 J=1,NOBS
        DO 113 J2=1,7
          K=K+1
          IF(J2.EQ.1) PLAGE(J,J2)=FLOAT(IOPLAG(K))/10.
          IF(J2.GT.1.OR.J2.LT.7) THEN
            PLAGE(J,J2)=IOPLAG(K)
          END IF
          IF(J2.EQ.7) PLAGE(J,J2)=FLOAT(IOPLAG(K))/10.
 113    CONTINUE
 112   CONTINUE
C
C      WRITE SPECIFIED RECORDS
C
C      IF(I.LT.30) THEN
       IF(I.GE.IREC1.AND.I.LE.IREC2) THEN
         WRITE(6,1005) I,YEAR,DAY,NOBS,ISS,MHZ,CAL,IGEO
 1005    FORMAT(1X,I4,2X,I4,2X,I3,2X,I4,2X,I3,2X,F5.1,2X,F5.1,2X,I4/)
         IF(NOBS.EQ.0) WRITE(6,1006) (IOPLAG(J6),J6=1,7)
 1006    FORMAT(48X,F5.1,2X,F8.0,2X,F5.0,2X,F5.0,2X,F5.0,2X,F6.1,
     1          2X,F5.1)
         IF(NOBS.GT.0) THEN
           DO 105 J7=1,NOBS
             WRITE(6,1006) (PLAGE(J7,J8),J8=1,7)
  105      CONTINUE
         END IF
       END IF
  100 CONTINUE
      WRITE(6,3001)
 3001 FORMAT(//' END OF FILE 4 PROCESSING'//)
      RETURN
      END
```

OPEN FILE 1 TO READ DATA

NOPS STANDARD HEADER LABEL

NIMBUS-7 NOPS SPEC NO T133011 SQ NO AS83201-1 ERB SACC TO SACC START 1978 320 000000 TO 1983 304 000000 GEN 1984 192 093142

NIMBUS-7 NOPS SPEC NO T133011 SQ NO AS83201-1 ERB SACC TO SACC START 1978 320 000000 TO 1983 304 000000 GEN 1984 192 093142

END OF FILE 1 PROCESSING

OPEN FILE 2 TO READ DATA

DAILY MEAN ERB SOLAR DATA

FIVE YEARS OF ESAT DAILY MEAN DATA FROM NIMBUS 7

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 1 RECORD IDENTIFICATION=100

	M	S	MI	MA	N
ORBIT NUMBER	325.000	0.00000	323	327	5
YEAR	78				
DAY OF YEAR	320				
SOLAR AZIMUTH	-4.0200	0.238747	-4.3	-3.7	5
SOLAR ELEVATION	-0.9400	1.55981	-3.7	0.1	5
GAMMA ANGLE	4.00000	0.00000	4	4	5
CH. 3 TEMP. IN DEG. C NOT SCALED	19.6400	0.32094	19.3	20.1	5
CH.10C TEMP. IN DEG. C NOT SCALED	20.1600	0.33615	19.8	20.6	5
CH. 1 IRR. NOT SCALED	1369.0	-9999.00000	1369.0	1369.0	1
CH. 2 IRR. NOT SCALED	1354.16	0.43932	1353.7	1354.8	5
CH. 3 IRR. NOT SCALED	1381.83	0.503322	1381.3	1382.3	3
CH. 4 IRR. NOT SCALED	987.220	0.33466	986.8	987.6	5
CH. 5 IRR. NOT SCALED	692.520	0.16432	692.4	692.8	5
CH. 6 IRR. NOT SCALED	206.440	0.09192	206.30	206.55	5
CH. 7 IRR. NOT SCALED	166.818	0.046583	166.79	166.90	5
CH. 8 IRR. NOT SCALED	108.816	0.025100	108.79	108.84	5
CH. 9 IRR. NOT SCALED	61.3240	0.020736	61.29	613.40	5
CH.10C IRR. NOT SCALED	1370.74	C.230217	1370.4	1371.0	5
MISSION DAY	1				
OFF AXIS ANGLE IN DEG.	-0.0200	0.23875	-0.3	0.3	5
COS. CORRECTED SEFDT SOLAR IRR. CH.10C	1370.75	0.23215	1370.41	13710.20	5

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 2 RECORD IDENTIFICATION=100

	M	S	MI	MA	N
ORBIT NUMBER	330.000	0.00000	328	332	5
YEAR	78				
DAY OF YEAR	321				
SOLAR AZIMUTH	-3.9800	0.216795	-4.2	-3.7	5
SOLAR ELEVATION	-2.2600	1.92562	-4.2	0.0	5
GAMMA ANGLE	5.00000	1.00000	4	6	5
CH. 3 TEMP. IN DEG. C NOT SCALED	21.2800	0.54498	20.5	21.9	5
CH.10C TEMP. IN DEG. C NOT SCALED	21.7800	0.48166	21.1	22.3	5
CH. 1 IRR. NOT SCALED	1369.9	-9999.00000	1369.9	1369.9	1
CH. 2 IRR. NOT SCALED	1357.26	3.48827	1353.4	1360.9	5
CH. 3 IRR. NOT SCALED	1382.55	0.353553	1382.3	1382.8	2
CH. 4 IRR. NOT SCALED	990.420	3.66224	986.9	994.3	5
CH. 5 IRR. NOT SCALED	692.820	0.46043	692.4	693.6	5
CH. 6 IRR. NOT SCALED	207.152	0.86693	206.14	208.27	5
CH. 7 IRR. NOT SCALED	166.870	0.221698	166.59	167.21	5
CH. 8 IRR. NOT SCALED	108.778	0.123167	108.66	108.91	5
CH. 9 IRR. NOT SCALED	61.5080	0.221292	61.27	617.40	5
CH.10C IRR. NOT SCALED	1371.06	0.712741	1370.0	1371.8	5

ISSION DAY	2				
FF AXIS ANGLE IN DEG.	1.0200	1.04738	-0.2	2.1	5
OS. CORRECTED SEFDT SOLAR IRR. CH.10C	1371.46	0.36932	1370.92	13719.30	5

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 3 RECORD IDENTIFICATION=100

	M	S	MI	MA	N
RBIT NUMBER	353.500	0.00000	352	355	4
EAR	78				
AY OF YEAR	322				
OLAR AZIMUTH	-4.0000	0.182574	-4.2	-3.8	4
OLAR ELEVATION	-1.1250	1.84719	-3.9	0.0	4
AMMA ANGLE	4.00000	0.00000	4	4	4
H. 3 TEMP. IN DEG. C NOT SCALED	20.1250	0.05000	20.1	20.2	4
H.10C TEMP. IN DEG. C NOT SCALED	20.6750	0.05000	20.6	20.7	4
H. 1 IRR. NOT SCALED	-9999.0	-9999.00000	-9999.0	-9999.0	0
H. 2 IRR. NOT SCALED	1352.02	0.20616	1351.8	1352.2	4
H. 3 IRR. NOT SCALED	1381.85	0.450925	1381.3	1382.4	4
H. 4 IRR. NOT SCALED	986.625	0.23629	986.3	986.8	4
H. 5 IRR. NOT SCALED	692.450	0.12910	692.3	692.6	4
H. 6 IRR. NOT SCALED	205.880	0.06583	205.81	205.95	4
H. 7 IRR. NOT SCALED	166.057	0.053151	165.99	166.12	4
H. 8 IRR. NOT SCALED	108.375	0.038730	108.33	108.42	4
H. 9 IRR. NOT SCALED	60.7600	0.016330	60.74	607.80	4
H.10C IRR. NOT SCALED	1371.37	0.206155	1371.1	1371.6	4
ISSION DAY	3				
FF AXIS ANGLE IN DEG.	0.0000	0.18257	-0.2	0.2	4
OS. CORRECTED SEFDT SOLAR IRR. CH.10C	1371.38	0.20364	1371.11	13716.00	4

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 4 RECORD IDENTIFICATION=100

	M	S	MI	MA	N

MISSING DATA FOR THIS OBSERVATION

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 5 RECORD IDENTIFICATION

	M	S	MI	MA	N
ORBIT NUMBER	378.500	0.00000	374	383	10
YEAR	78				
DAY OF YEAR	324				
SOLAR AZIMUTH	-4.1000	0.205480	-4.3	-3.7	10
SOLAR ELEVATION	-0.3900	1.38840	-4.3	0.4	10
GAMMA ANGLE	4.00000	0.00000	4	4	10
CH. 3 TEMP. IN DEG. C NOT SCALED	20.4400	0.27162	19.9	20.8	10
CH.10C TEMP. IN DEG. C NOT SCALED	20.9400	0.29515	20.3	21.3	10
CH. 1 IRR. NOT SCALED	-9999.0	-9999.00000	-9999.0	-9999.0	0
CH. 2 IRR. NOT SCALED	1348.78	0.60700	1347.9	1349.6	10
CH. 3 IRR. NOT SCALED	1381.87	0.400139	1381.3	1382.5	10
CH. 4 IRR. NOT SCALED	986.220	0.30478	985.8	986.7	10
CH. 5 IRR. NOT SCALED	692.240	0.10750	692.0	692.4	10
CH. 6 IRR. NOT SCALED	205.186	0.13243	204.99	205.30	10
CH. 7 IRR. NOT SCALED	164.995	0.158833	164.76	165.23	10
CH. 8 IRR. NOT SCALED	107.324	0.197327	106.93	107.61	10
CH. 9 IRR. NOT SCALED	60.0590	0.108572	59.91	602.10	10
CH.10C IRR. NOT SCALED	1371.15	0.327448	1370.6	1371.6	10
MISSION DAY	5				
OFF AXIS ANGLE IN DEG.	-0.1000	0.20548	-0.3	0.3	10
COS. CORRECTED SEFDT SOLAR IRR. CH.10C	1371.16	0.32598	1370.60	13716.00	10

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 6 RECORD IDENTIFICATION=100

	M	S	MI	MA	N
ORBIT NUMBER	390.615	0.00000	384	397	13
YEAR	78				
DAY OF YEAR	325				
SOLAR AZIMUTH	-3.9769	0.220431	-4.3	-3.7	13
SOLAR ELEVATION	-0.4385	1.18078	-4.3	0.2	13
GAMMA ANGLE	4.00000	0.00000	4	4	13
CH. 3 TEMP. IN DEG. C NOT SCALED	21.8692	0.87691	20.3	22.7	13
CH.10C TEMP. IN DEG. C NOT SCALED	22.3615	0.88274	20.8	23.2	13
CH. 1 IRR. NOT SCALED	-9999.0	-9999.00000	-9999.0	-9999.0	0

	M	S	MI	MA	N
CH. 2 IRR. NOT SCALED	1346.79	0.74326	1345.9	1348.3	13
CH. 3 IRR. NOT SCALED	1381.78	0.313172	1381.3	1382.4	13
CH. 4 IRR. NOT SCALED	985.723	0.24205	985.3	986.1	13
CH. 5 IRR. NOT SCALED	692.085	0.22303	691.8	692.6	13
CH. 6 IFR. NOT SCALED	204.799	0.17678	204.58	205.18	13
CH. 7 IRR. NOT SCALED	164.392	0.195442	164.18	164.74	13
CH. 8 IRR. NOT SCALED	106.677	0.166703	106.48	106.91	13
CH. 9 IRR. NOT SCALED	59.6923	0.107250	59.56	599.00	13
CH.10C IRR. NOT SCALED	1371.07	0.235884	1370.8	1371.6	13
MISSION DAY	6				
OFF AXIS ANGLE IN DEG.	0.0231	0.22043	-0.3	0.3	13
COS. CORRECTED SEFDT SOLAR IRR. CH.10C	1371.08	0.23794	1370.80	13716.20	13

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 7 RECORD IDENTIFICATION=100

	M	S	MI	MA	N
ORBIT NUMBER	404.000	0.00000	398	410	13
YEAR	78				
DAY OF YEAR	326				
SOLAR AZIMUTH	-3.9846	0.215430	-4.3	-3.6	13
SOLAR ELEVATION	-0.7769	1.58017	-4.3	0.2	13
GAMMA ANGLE	4.00000	0.00000	4	4	13
CH. 3 TEMP. IN DEG. C NOT SCALED	21.0231	0.83681	20.4	22.7	13
CH.10C TEMP. IN DEG. C NOT SCALED	21.5385	0.83220	20.9	23.2	13
CH. 1 IRR. NOT SCALED	-9999.0	-9999.00000	-9999.0	-9999.0	0
CH. 2 IRR. NOT SCALED	1344.69	1.00122	1343.6	1346.9	13
CH. 3 IRR. NOT SCALED	1381.68	0.353916	1381.1	1382.3	13
CH. 4 IRR. NOT SCALED	985.369	0.20569	985.0	985.7	13
CH. 5 IRR. NOT SCALED	691.931	0.17974	691.7	692.2	13
CH. 6 IRR. NOT SCALED	204.370	0.23216	204.10	204.91	13
CH. 7 IRR. NOT SCALED	163.784	0.227579	163.46	164.21	13
CH. 8 IRR. NOT SCALED	106.108	0.225505	105.80	106.46	13
CH. 9 IRR. NOT SCALED	59.2623	0.172054	59.05	595.70	13
CH.10C IRR. NOT SCALED	1371.14	0.278503	1370.5	1371.5	13
MISSION DAY	7				
OFF AXIS ANGLE IN DEG.	0.0154	0.21543	-0.3	0.4	13
COS. CORRECTED SEFDT SOLAR IRR. CH.10C	1371.15	0.27857	1370.52	13715.10	13

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 8 RECORD IDENTIFICATION=100

	M	S	MI	MA	N
ORBIT NUMBER	411.000	-9999.00000	411	411	1
YEAR	78				
DAY OF YEAR	327				
SOLAR AZIMUTH	-3.7000	-9999.000000	-3.7	-3.7	1
SOLAR ELEVATION	-0.2000	-9999.00000	-0.2	-0.2	1
GAMMA ANGLE	4.00000	-9999.00000	4	4	1
CH. 3 TEMP. IN DEG. C NOT SCALED	20.4000	-9999.00000	20.4	20.4	1
CH.10C TEMP. IN DEG. C NOT SCALED	20.9000	-9999.00000	20.9	20.9	1
CH. 1 IRR. NOT SCALED	-9999.0	-9999.00000	-9999.0	-9999.0	0
CH. 2 IRR. NOT SCALED	1344.20	-9999.00000	1344.2	1344.2	1
CH. 3 IRR. NOT SCALED	1381.70	-9999.000000	1381.7	1381.7	1
CH. 4 IRR. NOT SCALED	985.200	-9999.00000	985.2	985.2	1
CH. 5 IRR. NOT SCALED	692.200	-9999.00000	692.2	692.2	1
CH. 6 IRR. NOT SCALED	204.270	-9999.00000	204.27	204.27	1
CH. 7 IRR. NOT SCALED	163.450	-9999.000000	163.45	163.45	1
CH. 8 IRR. NOT SCALED	105.820	-9999.000000	105.82	105.82	1
CH. 9 IRR. NOT SCALED	59.0400	-9999.000000	59.04	590.40	1
CH.10C IRR. NOT SCALED	1371.30	-9999.000000	1371.3	1371.3	1
MISSION DAY	8				
OFF AXIS ANGLE IN DEG.	0.3000	-9999.00000	0.3	0.3	1
COS. CORRECTED SEFDT SOLAR IRR. CH.10C	1371.32	-9999.00000	1371.32	13713.20	1

M=MEAN S=SIGMA MI=MIN MA=MAX N=NUMBER OF ORBITS
RECORD NUMBER= 9 RECORD IDENTIFICATION=100

	M	S	MI	MA	N
ORBIT NUMBER	433.000	0.00000	423	438	11
YEAR	78				
DAY OF YEAR	328				
SOLAR AZIMUTH	-3.9727	0.190215	-4.2	-3.7	11
SOLAR ELEVATION	-0.2909	0.42533	-1.4	0.2	11
GAMMA ANGLE	4.00000	0.00000	4	4	11
CH. 3 TEMP. IN DEG. C NOT SCALED	19.6818	0.63217	18.1	20.1	11
CH.10C TEMP. IN DEG. C NOT SCALED	20.2182	0.64934	18.6	20.7	11

```
CH. 1 IRR. NOT SCALED                    -9999.0  -9999.00000     -9999.0     -9999.0        0
CH. 2 IRR. NOT SCALED                    1340.78      1.08703      1339.8      1343.9       11
CH. 3 IRR. NOT SCALED                    1381.61     0.383287      1381.1      1382.6       11
CH. 4 IRR. NOT SCALED                    985.018      0.97552       984.5       987.9       11
CH. 5 IRR. NOT SCALED                    691.855      0.40832       691.5       693.0       11
CH. 6 IRR. NOT SCALED                    203.424      0.14948      203.24      203.81       11
CH. 7 IRR. NOT SCALED                    162.545     0.183759      162.34      162.91       11
CH. 8 IRR. NOT SCALED                    104.956     0.145208      104.76      105.18       11
CH. 9 IRR. NOT SCALED                    58.4364     0.076586       58.32      585.40       11
CH.10C IRR. NOT SCALED                   1371.09     0.242712      1370.7      1371.4       11
MISSION DAY                                    9
OFF AXIS ANGLE IN DEG.                    0.0273      0.19022        -0.2         0.3       11
COS. CORRECTED SEFDT SOLAR IRR. CH.10C   1371.10      0.24232     1370.71    13714.10       11


    M=MEAN  S=SIGMA  MI=MIN  MA=MAX  N=NUMBER OF ORBITS
    RECORD NUMBER=   16  RECORD IDENTIFICATION=100
                                               M            S          MI          MA        N
ORBIT NUMBER                             445.500      0.00000         439         452       14
YEAR                                          78
DAY OF YEAR                                  329
SOLAR AZIMUTH                            -3.9286     0.223361        -4.3        -3.6       14
SOLAR ELEVATION                          -0.1000      0.26018        -0.6         0.3       14
GAMMA ANGLE                              4.00000      0.00000           4           4       14
CH. 3  TEMP. IN DEG. C NOT SCALED        21.5500      0.72084        20.1        22.3       14
CH.10C TEMP. IN DEG. C NOT SCALED        22.0571      0.71222        20.7        22.8       14
CH. 1 IRR. NOT SCALED                    -9999.0  -9999.00000     -9999.0     -9999.0        0
CH. 2 IRR. NOT SCALED                    1338.55      1.00441      1337.4      1340.4       14
CH. 3 IRR. NOT SCALED                    1381.96     0.336759      1381.3      1382.6       14
CH. 4 IRR. NOT SCALED                    984.264      0.28449       983.8       984.8       14
CH. 5 IRR. NOT SCALED                    691.629      0.22336       691.4       692.1       14
CH. 6 IRR. NOT SCALED                    202.921      0.28424      202.61      203.51       14
CH. 7 IRR. NOT SCALED                    161.781     0.340485      161.30      162.33       14
CH. 8 IRR. NOT SCALED                    104.207     0.319674      103.73      104.68       14
CH. 9 IRR. NOT SCALED                    58.0400     0.187535       57.76      583.10       14
CH.10C IRR. NOT SCALED                   1371.34     0.259013      1371.0      1371.9       14
MISSION DAY                                   10
OFF AXIS ANGLE IN DEG.                    0.0714      0.22336        -0.3         0.4       14
COS. CORRECTED SEFDT SOLAR IRR. CH.10C   1371.35      0.26141     1371.00    13719.30       14

END OF FILE 2 PROCESSING


OPEN FILE 3 FOR PROCESSING

         ORBITAL ERB SOLAR DATA

    FIVE YEARS OF ESAT ORBITAL DATA FROM NIMBUS 7
         ESD  = EARTH SUN DISTANCE


    RECORD NUMBER=    1  RECORD IDENTIFICATION=200
      ORBIT        YEAR        DAY OF       SOLAR        SOLAR         INSTR        GAMMA        MSB OF
      NUMBER                    YEAR       AZIMUTH     ELEVATION     STAT WORD      ANGLE         ESD
       323          78          320         -4.2         -0.5           0             4            1

     LSB OF     CH 3 DEG C  CH 10C DEG C   CH 1 IRR     CH 2 IRR     CH 3 IRR     CH 4 IRR     CH 5 IRR     CH 6 IRR
      ESD       ----------  ------------   --------     --------     --------     --------     --------     --------
     -32192        19.3         19.8        -999.9       1354.2       1381.9        987.5        692.4       206.45

    CH 7 IRR     CH 8 IRR     CH 9 IRR    CH 10C IRR    SOUTHTERM    SOUTHTERM     MISSION     OFF AXIS    COS CORR
    --------     --------     --------    ----------  TIME(HR/MIN)   TIME(SEC)       DAY      ANGLE(DEG)  SEFDT CH10C
     166.90       108.79        61.34       137.04        1524          42            1            0        1370.4


    RECORD NUMBER=    2  RECORD IDENTIFICATION=200
      ORBIT        YEAR        DAY OF       SOLAR        SOLAR         INSTR        GAMMA        MSB OF
```

ESD								
-32200	20.5	21.1	1369.9	1354.2	-999.9	986.9	692.8	206.58

CH 7 IRR	CH 8 IRR	CH 9 IRR	CH 10C IRR	SOUTHTERM TIME(HR/MIN)	SOUTHTERM TIME(SEC)	MISSION DAY	OFF AXIS ANGLE(DEG)	COS CORR SEFDT CH10C
166.84	108.91	61.34	137.14	5	14	2	0	1371.4

RECORD NUMBER= 7 RECORD IDENTIFICATION=200

ORBIT NUMBER	YEAR	DAY OF YEAR	SOLAR AZIMUTH	SOLAR ELEVATION	INSTR STAT WORD	GAMMA ANGLE	MSB OF ESD	
329	78	321	-3.9	-3.1	0	6	1	
LSB OF ESD	**CH 3 DEG C**	**CH 10C DEG C**	**CH 1 IRR**	**CH 2 IRR**	**CH 3 IRR**	**CH 4 IRR**	**CH 5 IRR**	**CH 6 IRR**
-32201	21.0	21.5	-999.9	1360.9	-999.9	994.3	692.7	207.77
CH 7 IRR	**CH 8 IRR**	**CH 9 IRR**	**CH 10C IRR**	**SOUTHTERM TIME(HR/MIN)**	**SOUTHTERM TIME(SEC)**	**MISSION DAY**	**OFF AXIS ANGLE(DEG)**	**COS CORR SEFDT CH10C**
166.88	108.66	61.74	137.07	149	30	2	2	1371.6

RECORD NUMBER= 8 RECORD IDENTIFICATION=200

ORBIT NUMBER	YEAR	DAY OF YEAR	SOLAR AZIMUTH	SOLAR ELEVATION	INSTR STAT WORD	GAMMA ANGLE	MSB OF ESD	
330	78	321	-3.9	-3.6	0	6	1	
LSB OF ESD	**CH 3 DEG C**	**CH 10C DEG C**	**CH 1 IRR**	**CH 2 IRR**	**CH 3 IRR**	**CH 4 IRR**	**CH 5 IRR**	**CH 6 IRR**
-32203	21.4	21.9	-999.9	1360.6	-999.9	994.1	692.6	208.27
CH 7 IRR	**CH 8 IRR**	**CH 9 IRR**	**CH 10C IRR**	**SOUTHTERM TIME(HR/MIN)**	**SOUTHTERM TIME(SEC)**	**MISSION DAY**	**OFF AXIS ANGLE(DEG)**	**COS CORR SEFDT CH10C**
167.21	108.73	61.74	137.00	333	30	2	2	1370.9

RECORD NUMBER= 9 RECORD IDENTIFICATION=200

ORBIT NUMBER	YEAR	DAY OF YEAR	SOLAR AZIMUTH	SOLAR ELEVATION	INSTR STAT WORD	GAMMA ANGLE	MSB OF ESD	
331	78	321	-4.2	-6.4	0	5	1	
LSB OF ESD	**CH 3 DEG C**	**CH 10C DEG C**	**CH 1 IRR**	**CH 2 IRR**	**CH 3 IRR**	**CH 4 IRR**	**CH 5 IRR**	**CH 6 IRR**
-32204	21.6	22.1	-999.9	1357.2	1382.8	989.9	693.6	207.00
CH 7 IRR	**CH 8 IRR**	**CH 9 IRR**	**CH 10C IRR**	**SOUTHTERM TIME(HR/MIN)**	**SOUTHTERM TIME(SEC)**	**MISSION DAY**	**OFF AXIS ANGLE(DEG)**	**COS CORR SEFDT CH10C**
166.83	108.91	61.45	137.18	517	46	2	1	1371.9

RECORD NUMBER= 10 RECORD IDENTIFICATION=200

ORBIT NUMBER	YEAR	DAY OF YEAR	SOLAR AZIMUTH	SOLAR ELEVATION	INSTR STAT WORD	GAMMA ANGLE	MSB OF ESD	
332	78	321	-4.2	-4.2	0	4	1	
LSB OF ESD	**CH 3 DEG C**	**CH 10C DEG C**	**CH 1 IRR**	**CH 2 IRR**	**CH 3 IRR**	**CH 4 IRR**	**CH 5 IRR**	**CH 6 IRR**
-32206	21.9	22.3	-999.9	1353.4	1382.3	986.9	692.4	206.14
CH 7 IRR	**CH 8 IRR**	**CH 9 IRR**	**CH 10C IRR**	**SOUTHTERM**	**SOUTHTERM**	**MISSION**	**OFF AXIS**	**COS CORR**

				TIME(HR/MIN)	TIME(SEC)	DAY	ANGLE(DEG)	SEFDT CH10C
166.59	108.68	61.27	137.14	701	46	2	0	1371.4

END OF FILE 3 PROCESSING

OPEN FILE 4 FOR PROCESSING

DAILY SOLAR ACTIVITY INDICATORS

ERB SOLAR ANALYSIS TAPE (ESAT)
SOLAR ACTIVITY INDICATORS
FILE # 3

OBS	YEAR	DAY	NOBS	SSN	SOLAR FLUX	DAILY CALCM	GEOM INDX	(SOLAR PLAGE DATA) CMPD	MHREG.NO	LATIT	CMDIS	C.LON	AREA	INTEN
1	78	320	19	77	156.7	15.8	6							
								173.0	15666.	27.	351.	313.	100.0	1.0
								160.0	15653.	39.	7.	329.	500.0	1.5
								159.0	15665.	11.	9.	331.	300.0	2.5
								158.0	15654.	-18.	12.	334.	600.0	2.0
								185.0	15662.	16.	335.	297.	600.0	1.5
								179.0	15661.	34.	343.	305.	200.0	1.5
								182.0	15658.	-27.	340.	302.	300.0	1.5
								154.0	15657.	-31.	15.	337.	100.0	1.5
								149.0	15671.	-17.	22.	344.	100.0	2.0
								105.0	15643.	20.	85.	47.	2100.0	3.0
								132.0	15647.	-23.	44.	6.	1600.0	2.5
								145.0	15651.	24.	27.	349.	1600.0	3.0
								132.0	15660.	25.	46.	8.	400.0	2.0
								97.0	15642.	-23.	82.	44.	800.0	1.0
								219.0	15667.	34.	294.	256.	1300.0	1.5
								224.0	15669.	-16.	284.	246.	3500.0	2.5
								212.0	15668.	-21.	301.	263.	500.0	3.0
								203.0	15663.	17.	311.	273.	700.0	2.5
								232.0	15670.	-27.	275.	237.	900.0	2.5
2	78	321	18	92	128.1	19.1	6							
								232.0	15670.	-27.	290.	234.	1300.0	3.0
								203.0	15663.	17.	327.	271.	700.0	2.0
								212.0	15668.	-22.	317.	261.	800.0	3.0
								219.0	15667.	34.	310.	254.	1100.0	1.5
								224.0	15669.	-16.	298.	242.	2700.0	3.0
								245.0	15673.	15.	271.	215.	400.0	2.0
								242.0	15672.	24.	274.	218.	600.0	1.5
								132.0	15660.	25.	62.	6.	300.0	1.5
								145.0	15651.	24.	44.	348.	1600.0	3.0
								132.0	15647.	-23.	60.	4.	1300.0	2.5
								149.0	15671.	-17.	39.	343.	1200.0	2.5
								154.0	15657.	-31.	30.	334.	100.0	1.5
								182.0	15658.	-27.	356.	300.	300.0	1.0
								179.0	15661.	34.	360.	304.	200.0	1.0
								185.0	15662.	16.	352.	296.	500.0	1.5
								158.0	15654.	-18.	29.	333.	700.0	2.0
								159.0	15665.	11.	25.	329.	500.0	2.5
								160.0	15653.	39.	23.	327.	700.0	1.0
3	78	322	9	93	127.4	0.0	5							
								158.0	15654.	-18.	12.	334.	600.0	2.0
								149.0	15671.	-17.	39.	343.	1200.0	2.5
								145.0	15651.	24.	27.	349.	1600.0	3.0
								132.0	15647.	-23.	60.	4.	1300.0	2.5
								145.0	15651.	24.	27.	349.	1600.0	3.0
								245.0	15673.	26.	60.	221.	600.0	1.0
								224.0	15669.	-16.	284.	246.	3500.0	2.5
								212.0	15668.	-22.	317.	261.	800.0	3.0
								232.0	15670.	-27.	290.	234.	1300.0	3.0
4	78	323	19	85	128.9	21.7	13							
								232.0	15670.	-27.	313.	235.	1000.0	3.5
								212.0	15668.	-22.	338.	260.	800.0	3.0

								203.0	15663.	17.	351.	273.	500.0	2.0
								214.0	15676.	-30.	336.	258.	100.0	1.0
								224.0	15669.	-16.	321.	243.	1800.0	3.0
								219.0	15667.	34.	332.	254.	1000.0	2.0
								242.0	15672.	25.	295.	217.	700.0	1.5
								263.0	15677.	-20.	272.	194.	500.0	1.0
								245.0	15673.	16.	289.	211.	1400.0	2.5
								145.0	15651.	24.	27.	349.	1600.0	3.0
								145.0	15651.	24.	65.	347.	1600.0	3.0
								149.0	15671.	-17.	61.	343.	700.0	2.5
								154.0	15657.	-31.	51.	333.	200.0	1.0
								158.0	15654.	-18.	50.	332.	1000.0	2.5
								160.0	15653.	40.	44.	326.	1700.0	3.5
								159.0	15665.	13.	50.	332.	800.0	2.0
								185.0	15662.	16.	13.	295.	500.0	2.0
								182.0	15658.	-27.	18.	300.	300.0	1.0
								179.0	15661.	34.	21.	303.	200.0	1.5
5	78	324	9	76	134.9	0.0	22							
								160.0	15653.	40.	44.	326.	1700.0	3.5
								158.0	15654.	-18.	50.	332.	1000.0	2.5
								145.0	15651.	24.	27.	349.	1600.0	3.0
								245.0	15673.	16.	289.	211.	1400.0	2.5
								224.0	15669.	-16.	321.	243.	1800.0	3.0
								214.0	15676.	-30.	336.	258.	100.0	1.0
								212.0	15668.	-22.	338.	260.	800.0	3.0
								232.0	15670.	-27.	290.	234.	1300.0	3.0
								263.0	15677.	14.	77.	214.	1800.0	3.0
6	78	325	6	68	[illegible]	0.0	16							
								263.0	15677.	-20.	351.	194.	2600.0	2.5
								232.0	15670.	-27.	290.	234.	1300.0	3.0
								212.0	15668.	-22.	338.	260.	800.0	3.0
								214.0	15676.	-30.	336.	258.	100.0	1.0
								224.0	15669.	-16.	321.	243.	1800.0	3.0
								160.0	15653.	40.	44.	326.	1700.0	3.5
7	78	326	4	77	127.1	0.0	28							
								160.0	15653.	40.	44.	326.	1700.0	3.5
								224.0	15669.	-16.	321.	243.	1800.0	3.0
								232.0	15670.	-27.	290.	234.	1300.0	3.0
								263.0	15677.	-20.	351.	194.	2600.0	2.5
8	78	327	4	55	121.9	0.0	12							
								285.0	15679.	-10.	66.	0.	300.0	1.5
								232.0	15670.	-27.	290.	234.	1300.0	3.0
								224.0	15669.	-16.	321.	243.	1800.0	3.0
								224.0	15669.	-16.	321.	243.	1800.0	3.0
9	78	328	1	61	123.5	0.0	18							
								232.0	15670.	-27.	290.	234.	1300.0	3.0
10	78	329	16	85	124.7	27.2	60							
								232.0	15670.	-27.	31.	234.	1000.0	3.0
								224.0	15669.	-16.	42.	245.	2000.0	3.0
								219.0	15667.	34.	49.	252.	800.0	1.5
								212.0	15668.	-24.	58.	261.	700.0	2.0
								203.0	15663.	17.	70.	273.	400.0	1.0
								245.0	15673.	16.	14.	217.	800.0	2.5
								242.0	15672.	26.	18.	221.	500.0	2.0
								285.0	15679.	15.	322.	165.	2000.0	3.0
								295.0	15680.	25.	309.	152.	900.0	2.5
								263.0	15677.	-20.	351.	194.	2600.0	2.5
								283.0	15678.	-13.	325.	168.	800.0	2.0
								20.0	15682.	17.	280.	123.	2000.0	2.5
								309.0	15683.	-13.	292.	135.	500.0	1.0
								306.0	15690.	14.	293.	136.	800.0	3.0
								299.0	15681.	10.	300.	143.	1100.0	3.5
								26.0	15684.	-22.	275.	118.	900.0	1.5

END OF FILE 4 PROCESSING